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NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

Analytical Chemistry

Refer also to abstract 47583.

Chemical Procedures

Refer also to abstracts 47408, 47449, 47577, 47638, 47714, 47739, 47947, 47954, 48480, and 48526.

47367 (CNEA-244) DETERMINATION OF THE OXYGEN/URANIUM RATIO IN HIGH-PURITY URANOUS OXIDE. I. APPLICATION TO POWDERED OXIDES. Casabe, Jaime; Botbol, Moises (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1969. 12p. (In Spanish). Dep. CFSTI (U. S. Sales Only).

A procedure for the determination of the ratio oxygen/uranium in high-purity U_3O_8 was developed. The method is based on dissolution of the oxide in concentrated phosphoric acid and determination of the uranium(VI) present in the sample by a polarographic method. Dissolution of the sample is performed in an inert atmosphere to avoid the effects of oxidation during this step. The relative standard deviation for oxides with O/U ratio near 2.1 is more than ±0.1%, and of the order of ±0.005% for the oxides with O/U ratio near 2.001. (auth)

47368 (CNEA-250) DETERMINATION OF THE OXYGEN/URANIUM RATIO IN HIGH-PURITY URANOUS OXIDE. [II]. APPLICATION TO SINTERED OXIDE PELLETS. Casabe, Jaime; Garcia, Enrique E.; Botbol, Moises (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1969. 8p. (In Spanish). Dep. CFSTI (U. S. Sales Only).

A procedure for determination of the ratio oxygen/uranium in sintered pellets of high purity U_3O_8 was developed. The method is based on partial dissolution of the pellet in concentrated phosphoric acid using a specially designed apparatus that permits processing under inert atmosphere. The uranium(VI) present in the sample is determined by a polarographic procedure, and the uranium(IV) by a potentiometric titration. The procedure described allows successive determinations of the oxygen/uranium ratio on the same pellet, and may be applied to the determination of oxygen/uranium ratios within the range 2.1 to 2.001. (auth)

47369 (ORNL-tr-2220) MASS SPECTROGRAPHIC ANALYSIS OF MINERALS AND ROCKS. Hintenberger, H. Translated by J. A. Carter (Oak Ridge National Lab., Tenn.), from Naturwissenschaften, 56: No. 5, 262-7(1969). 20p. Dep. CFSTI.

Techniques of mass spectrography are described and their applications to analyses of minerals, rocks, and meteorites discussed. Examples of the mass spectra of PbS, beryl, pitchblende, and meteorites are considered. (M.C.G.)

47370 (UCRL-71704) POST-IRRADIATION MICROANALYSIS. Albrecht, E. D.; Johnson, J. M.; Hayes, W. N. Jr. (California Univ., Livermore. Lawrence Radiation Lab.). Aug. 21, 1969. 6p. (CONF-690910-5). Dep. CFSTI.

From Symposium on Developments in Irradiation Testing Technology, Sandusky, Ohio.

A technique for examining 0.20-in.-dia by 0.75-in.-long irradiated fuel specimens was developed. Several pieces of specialized apparatus for decladding, subdividing, and analyzing these specimens are described or referenced, and a systematic procedure is given for dimensional measurement and chemical and metallographic analysis of such specimens. (auth)

47371 (WAPD-TM-851) SOME STUDIES ON THE OXIDATION STATES OF FISSION-PRODUCT IODINE (^{129}I) IN IRRADIATED UO_2 (LWBR DEVELOPMENT PROGRAM). Clayton, J. C.; Riddle, J. M. (Bettis Atomic Power Lab., Pittsburgh, Pa.). July 1969. Contract AT-11-1-GEN-14. 22p. Dep. CFSTI.

Both the UO_2 fuel and Zircaloy cladding from seven irradiated ($\sim 5 \times 10^{20}$ fissions/cm^3) PWR blanket rods were leached, first with methyl chloroform to extract any free iodine, followed by a second extraction with water to collect iodide and iodate ions. Only trace amounts of ^{129}I activity were detected in the organic leaching solutions, but definite ^{129}I peaks were identified in the water leachings of the UO_2 fuel from one rod. Further leachings with HCl solutions increased the amount of ^{129}I extracted. It was concluded that, for the quantity of ^{129}I leached from the irradiated UO_2, the major fraction is in the combined iodine (probably as iodide) rather than in the free iodine elemental state. The dominant amount of iodine is most likely tightly chemically bound, probably with metallic fission products. This appears reasonable because the oxidation reaction between unirradiated UO_2 and I_2, as evidenced by x-ray diffraction measurements, would permit the reduction to iodide of any fission-product free iodine produced by fissioning. (auth)

47372 THE DETERMINATION OF PHOSPHORUS ISOTOPES ^{32}P AND ^{33}P IN THE ATMOSPHERE. 1. ON COPRECIPITATION OF PHOSPHATES WITH FERRIC HYDROXIDE. Shopauskene, D. A.; Shvedov, V. P. (Inst. of Physics and Mathematics, Vilnyus, USSR). Liet. TSR Mokslu Akad. Darbai, Ser. B, 4: No. 55, 99-103(1968). (In Russian).

Adsorption of phosphates on ferric hydroxide from aqueous solutions in the absence of secondary electrolytes and in the presence of Na^+, K^+, Ca^{2+}, Mg^{2+}, SO_4^{2-}, Cl^-, and CO_3^{2-} at concentrations close to or twice as high as those in the atmospheric fallout have been studied by means of radioactive isotope ^{32}P. The investigation was carried out at 18 to 20°C in solutions of pH 8 to 9 and solution volume 500 ml. It was established that when concentrating phosphates from diluted solutions it was most reasonable to carry out precipitation in terms of 1 mg Fe^{3+} to 0.05 to 0.10 mg PO_4^{3-}. It was found that addition of all the ions mentioned above, in the quantities close to and twice as large as their concentrations in the atmospheric fallout had no effect on precipitation of phosphates with ferric hydroxide. (auth)

47373 DETERMINATION OF PLUTONIUM. Cauchetier, Ph. pp 93-101 of Traitement des Combustibles Irradies. Fontenay-aux-Roses, Centre d'Etudes Nucleaires, [1968]. (In French).

From 1st Franco-Spanish Colloquium on the Processing of Irradiated Fuels, Fontenay-aux-Roses, France. See CONF-671143.

It is impossible to speak of the reprocessing of irradiated fuels without raising the problem of the determination of plutonium. The methods most used by analysts are described briefly: physical methods, spectrophotometric methods based either on the absorption of plutonium itself or on that of colored complexes, gravimetric methods, volumetric methods, and methods using the oxidation-reduction properties of plutonium. The last-mentioned are considered chiefly because they are used especially when the analyst has sufficient material at his disposal and especially for analyses for balance sheets. They can be regrouped in three categories according to the principle on which they are based: oxidation of Pu(III) to Pu(IV), reduction of Pu(VI)

to Pu(IV), and coulometry on the system Pu(III)/Pu(IV). After a brief review of the existing methods of operation, there is a description of those currently in use with the reasons for choosing them. (tr-auth)

47374 SPECTROPHOTOMETRIC DETERMINATION OF PLUTONIUM BY MEANS OF ORGANIC REAGENTS. COMPARATIVE STUDY OF ARSENAZO I AND ARSENAZO III. Perez-Bustamante, J. A. (Junta de Energia Nuclear, Madrid). pp 103-31 of Traitement des Combustibles Irradies. Fontenay-aux-Roses, Centre d'Etudes Nucleaires, [1968]. (In Spanish).

From 1st Franco-Spanish Colloquium on the Processing of Irradiated Fuels, Fontenay-aux-Roses, France. See CONF-671143.

Arsenazo I and Arsenazo III were selected for study for spectrophotometric determination of plutonium. Arsenazo I has the principal advantages of having excellent kinetic qualities and of the reproducibility of the results of its complex with Pu(IV); its reaction with Pu(VI) not being appreciable. The reaction of Arsenazo III with Pu(IV) is extremely sensitive (4 to 5 times as great as Arsenazo I), resulting, compared with Arsenazo I, in a considerable reduction in the number and magnitude of the anionic and cationic interferences that affect the complex. The fundamental inconvenience with Arsenazo III is in the unsatisfactory reproducibility of its reactions with Pu(IV), which depend to a great extent on the quantity of excess reagent. Arsenazo III oxidizes Pu(III) and reduces Pu(VI) quantitatively in a few hours, which can be either an advantage or disadvantage depending on the situation. A simple method is described for bringing about the quantitative transformation in situ of total ionic plutonium to Pu(IV) in 30 seconds by making use of hot H_2O_2 and $NaNO_2$ in 7N HNO_3. The applicability of different reagents was investigated in order to follow the course of the various kinetic processes related to the interconversions of valence, making use of pure solutions of plutonium in sulfuric, nitric, and perchloric media. It was concluded that the simultaneous use of the two Arsenazos constitutes an excellent complement for the spectrophotometric determination of plutonium. Actually it makes use of an extraction–spectrophotometric method for the determination of plutonium in the organic phase using TOPO (trioctylphosphine oxide) and Arsenazo I. The provisional results are very promising. (tr-auth)

47375 STUDIES OF MORPHOLINE-N-DITHIOCARBOXYLIC ACID MORPHOLINIUM (MDCM) AS REAGENT IN QUANTITATIVE ANALYSIS. VII. Likussar, W.; Beyer, W.; Wawschinek, O. (Univ., Graz). Mikrochim. Acta, No. 5, 974-80(1969). (In German).

The behavior of morpholine-N-dithiocarboxylic acid morpholinium (MDCM) in aqueous solution, its decomposition velocity in dependence on pH, and the extraction of the reagent with chloroform are described and discussed with regard to analytical applications. (auth)

47376 DETERMINATION OF NITROGEN IN URANIUM NITRIDES BY DISSOLUTION WITH A MIXTURE OF STRONG PHOSPHORIC AND SULFURIC ACIDS. Itoh, Jiroh; Kizawa, Atsushi; Akimoto, Yumi (Mitsubishi Metal Mining Co., Ltd., [Omiya], Japan). Nippon Genshiryoku Gakkaishi, 11: 550-4(1969). (In Japanese).

Kjeldahl procedures were applied to the determination of nitrogen in uranium nitrides. Preliminary dissolution tests showed that none of the previously reported dissolution reagents, such as hydrochloric, hydrofluoric, and sulfuric acids, sulfuric and perchloric acids, sulfuric acid and copper selenate are strong enough to dissolve the uranium nitride, even at high temperatures. The best results were obtained with a mixture of strong phosphoric and sulfuric acids. Compared with other reported dissolution reagents, the proposed reagent gave excellent results with all the samples examined. Nitrogen recovery proved to be 100 ± 0.50%. (auth)

47377 MOLYBDENUM AND TUNGSTEN ELECTRODES FOR POTENTIOMETRIC INDICATION IN THE VOLUMETRIC DETERMINATION OF MOLYBDENUM, TUNGSTEN, AND LEAD. Geyer, Rudolf; Neumann, Manfred (Technische Hochschule fuer Chemie Carl Schorlemmer, Leuna-Merseburg, Ger.). Acta Chim. Acad. Sci. Hung., 60: 349-55(1969). (In German).

Molybdenum and tungsten electrodes respond to lead ions at 50°C approximately in the sense of the Nernst equation. By this strange-ion potential formation, the known indication ability in the potentiometric precipitation titration of tungsten and molybdenum with lead(II) in buffered media is explained. In nonbuffered states a mixed potential is obtained; hydrolytic pH changes affect the height of the potential transition in the equivalence point. (tr-auth)

47378 THE DETERMINATION OF GALLIUM IN THE PRESENCE OF TUNGSTEN. Vadasdi, Karoly G. (Research Inst. for Technical Physics, Budapest). Chem. Anal. (Warsaw), 14: 733-9(1969).

A direct photometric method has been developed for the determination of 5 to 50 μg of gallium in the presence of large amounts of tungsten. The procedure is based on the formation of the 4-(2-pyridylazo)resorcinol complex of gallium. The color reaction hindering effect of polytungstates was eliminated by H_2O_2 and the interfering effects of Cu, Cd, Ni, Zn, and Fe by potassium cyanide. The accuracy of the determination is ±5%. (auth)

47379 IDENTIFICATION OF METHYL IODIDE FORMED IN IODINE BY A MASS SPECTROMETER. Murata, Toshifumi; Inoue, Kiyoshi; Kobayashi, Tadao (Hitachi Ltd., Ibaraki, Japan). J. Nucl. Sci. Technol. (Tokyo), 6: 545-7(Sept. 1969).

Mass spectrometric results are reported from experiments on the identification of methyl iodide in iodine samples prepared by different methods. The amount of methyliodide found in samples prepared by oxidation of NaI with H_2O_2 was below 10^{-6}; in samples prepared by purification of CS_2 extraction was 3.6×10^{-2}; in samples prepared by thermal decomposition of PdI_2 was 8×10^{-1}; and in samples prepared by oxidation of solid NaI with $K_2Cr_2O_7$ at elevated temperature was 4.3×10^{-4}. (D.H.M.)

47380 CHARACTERISTICS OF THE ATOMIC-ABSORPTION DETERMINATION OF MOLYBDENUM IN A GRAPHITE CELL. Bodrov, N. V.; Nikolaev, G. I. (Central Scientific-Research Inst. of Metallurgy and Welding, Leningrad). Zh. Anal. Khim., 24: 1314-18(Sept. 1969). (In Russian).

An atomic-absorption method with the use of a heated (up to 2600°C) graphite cell has been applied to the determination of down to 3×10^{-10} g of molybdenum in various metals and alloys. It has been found that accompanying elements (with the exception of certain amounts of titanium and niobium) do not interfere with the molybdenum determination. The effectiveness of the method has been proved taking as an example the determination of 10^{-5} to 10^{-4}% of molybdenum in lead, cadmium, selenium, and zinc. (auth)

47381 A NEW ISOTOPIC ANALYSIS METHOD BY NUMERICAL INTEGRATION OF PEAKS. APPLICATION TO BORON ISOTOPES. Chambu, C.; Huynh, C. T.; Blanc, C.; Espagno, L. Centre de Recherches SNPA, Pau, France). Method. Phys. Anal., 4: 167-9(June 1968). (In French).

A mass spectrometer equipped with a high-frequency discharge ion source and with numerical integration of peaks was used in isotopic analysis. Boron isotopes in boron trifluoride were chosen and it is shown that, for several values of the isotopic ratio of samples, results agree with those obtained on a classical mass spectrometer. (auth)

47382 PHYSICO-CHEMICAL METHODS USED TO DETERMINE THE TRACES. Pinta, M. (ORSTOM, Bondy, France). Method. Phys. Anal., 4: 179-92(June 1968). (In French).

After a brief definition of the trace elements and their physical, chemical, biological, toxicological properties, the principal physico-chemical methods for their determination were examined: spectrophotometry, fluorimetry, polarography, spectrography, of emission of arc and spark, mass spectroscopy, and x-ray fluorescence. The applicability of each method is discussed; sensitivity, precision, rapidity, reproducibility, profitableness, and costs. The instrumental analysis, added to an appropriate physical and chemical preparation of the analyzed sample, enables contents of 10^{-9} to 10^{-5} to be determined. (auth)

47383 NEW EXPERIMENTS WITH LASER SOURCE MASS SPECTROMETER. Eloy, J. F. (CEN, Grenoble, France). Method. Phys. Anal., 4: 161-4(June 1968). (In French).

An ion source using the laser impact was designed and mounted on a magnetic deviation mass spectrometer. The characteristics of this device were studied with the help of different samples such as Al, Mg, Cu, and Ti. Measurements of isotopic ratios were carried out. The present sensitivity of the device permits disclosing isotopes with an isotopic abundance not exceeding 5%. (auth)

47384 SOLVENT EXTRACTION OF THE RARE EARTH ELEMENTS AS COMPLEXES WITH 5,7-DIBROMO-8-HYDROXYQUINOLINE AND RHODAMINE C. Poluektov, N. S.; Mishchenko, V. T. (Inst. of General and Inorganic Chemistry, Odessa). Zh. Anal. Khim., 24: 1434-6(Sept. 1969). (In Russian).

Ions of the rare earth elements form complexes with 5,7-dibromo-8-hydroxyquinoline and rhodamine C which can be extracted with benzene. The composition of the complexes is $R[MeDBO_4]$. The possibility of determining the rare earth elements by an extraction-spectrophotometric method is reported. The sensitivity of the method is 0.09 to 0.05 μg/ml for lanthanides

and 0.04 μg/ml for yttrium (as Me_2O_3) when a cell with a path length of 2.5 mm is used. (auth)

47385 SOLVENT EXTRACTION OF NEODYMIUM AND NIOBIUM AS CHELATE COMPOUNDS WITH 1-PHENYL-3-METHYL-4-BENZOYLPYRAZOLONE-5. DETERMINATION OF NEODYMIUM IN MONOCRYSTALS OF LITHIUM NIOBATE. Sizonenko, N. T.; Zolotov, Yu. A. (All-Union Scientific-Research Inst. of Monocrystals, Scintillation Materials, and Specially Pure Chemicals, Kharkov. Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Anal. Khim., 24: 1341-6(Sept. 1969). (In Russian).

Solvent extraction of neodymium and niobium as complexes with 4-benzoyl-3-methyl-1-phenyl-2-pyrazolin-5-one (PMBP) has been studied. The extraction constant of the neodymium PMBP complex in the system chloroform–water has been determined. On the basis of the data obtained a method has been developed for separating the above elements by means of PMBP. The method has been applied to the determination of neodymium (up to 1%) in monocrystals of lithium niobate. (auth)

47386 SPOT MODIFICATION OF THE KINETIC METHOD FOR DETERMINING MICROAMOUNTS OF MOLYBDENUM. Pavlova, V. K.; Yatsimirskii, K. B. (Inst. of General and Inorganic Chemistry, Kiev). Zh. Anal. Khim., 24: 1347-51(Sept. 1969). (In Russian).

A quantitative modification of a spot method has been developed for determining microamounts of molybdenum. The method is based on catalytic acceleration of the oxidation of rubeanic acid (dithiooxamide) by hydrogen peroxide in the presence of traces of molybdenum. The detected minimum is 2×10^{-3} μg. The possibility of determining 0.01 to 0.1% of molybdenum in a suspension of seawater of 1 mg or less is discussed. The relative error of the determination is not more than ±20%. (auth)

Isotopic Procedures

47387 EVALUATION OF THREE ISOTOPE-DILUTION TECHNIQUES FOR STUDYING THE KINETICS OF GLUCOSE METABOLISM IN SHEEP. White, R. G.; Steel, J. W.; Leng, R. A.; Luick, J. R. (Univ. of New England, Armidale, New South Wales). Biochem. J., 114: 203(Sept. 1969).

Comparisons were made of three isotope-dilution techniques for measuring parameters of glucose metabolism in sheep. [U–^{14}C] Glucose was used in all experiments. Conventional analyses of all results showed that similar estimates of the irreversible loss of glucose were obtained using all three techniques. A number of methods of analysis are discussed and a model for glucose metabolism in sheep is suggested. (auth) (UK)

Radiometric Procedures

Refer also to abstracts 47612, 47878, 47879, 47908, 47909, and 48065.

47388 THE LOSS OF CERIUM, COBALT, MANGANESE, PROTACTINIUM, RUTHENIUM, AND ZINC DURING DRY ASHING OF BIOLOGICAL MATERIAL. Strohal, P.; Lulic, S.; Jelisavcic, O. (Inst. Rudjer Boskovic, Rovinj, Yugoslavia). Analyst, 94: 678-80(Aug. 1969).

The mollusc Mytillus galloprovincialis was allowed to take up radioisotopes of cerium, cobalt, manganese, protactinium, ruthenium, and zinc from sea water. The loss of radioactivity when the molluscan soft tissues were heated to between 110° and 800°C in air was investigated. All the elements studied were partly volatilized, even at low ashing temperatures. For this reason wet ashing is recommended for the determination of radioactive contaminants in biological material. (auth) (UK)

47389 COLLOID FILTRATION AS A PREPARATIVE METHOD FOR THE RADIOCHEMICAL ANALYSIS OF BIOLOGICAL SAMPLES. Kanapilly, G. M.; Yaeger, D. J. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.). Health Phys., 17: 579-91(Oct. 1969).

A simple, reliable, rapid, and efficient method for the radiochemical analysis of polyvalent nuclides in biological samples is described. The method consists of homogenizing, prefiltering at pH 1 and separating the nuclide as the hydrogen phosphate by filtering through a 0.3 μ membrane filter paper at pH 5.0. Optimum conditions were established with respect to pH, carrier concentration, filter paper pore size, and the elimination of chelating agents such as EDTA. The particulate matter filtered was of colloidal size (diameter 0.1 μ). Chemical analysis and isotope dilution studies established that for Y the particulate matter was $Y_2(HPO_4)_3$. The radiometric yield for ^{91}Y in dog urine was 97 ± 1.0%. Yields for ^{144}Ce(IV), ^{155}Eu(III) and ^{147}Pm(III) were about 97%. Contamination of Y particulate matter by both Ca and Sr was about 1% at pH 5.0 and about 35% at pH 8.0. This procedure eliminates tedious wet ashing steps, yields thin counting samples and minimizes radiochemical and counting errors. It is an excellent procedure for weak beta emitters such as ^{147}Pm. Since it is fast and simple, this method is well suited for routine analysis of large numbers of radiobiological samples. (auth) (UK)

47390 INEXPENSIVE METHOD FOR MEASURING TRITIUM IN THE PRESENCE OF CAESIUM CHLORIDE. Phillips, A. P. (Medical Research Council, Harwell, Eng.). Nature (London), 223: 1055-6(Sept. 6, 1969).

It is difficult to assay a weak β-emitter, such as T, in the presence of high salt concentrations, as for example after the equilibrium sedimentation of labeled nucleic acids in density gradients of CsCl. A technique is described that allows a counting efficiency comparable with that obtained with a commercial dioxan based scintillator, at much lower cost. Some measurements are described on $CsCl/K_3PO_4/^3H$–DNA systems, and similar systems containing thymidine methyl–^{3}H. The method involves the addition of colloidal silica and 1.5 to 2 mm glass balls to the system, together with a scintillator solution prepared by dissolving a "Scintipak" (Thorn–Bendix, Ltd.) in toluene. The system was shaken vigorously, and bombardment by the glass balls freed much of the CsCl crust from the vial walls. The vials were counted for T in the Beckman liquid scintillation system. Some results are tabulated. Comparative measurements were also made using NE 240 dioxan based scintillator (Nuclear Enterprises Ltd.). The counting efficiency of the method was determined with a standardized solution of n-hexadecane-1,2-^{3}H. (UK)

47391 ANALYSIS OF THE ACTIVITY OF RADON DAUGHTER SAMPLES BY WEIGHTED LEAST SQUARES. Raabe, Otto G. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.); Wrenn, McDonald E. Health Phys., 17: 593-605(Oct. 1969).

A new mathematical method employing weighted least-squares was developed for the analysis of air samples for radon daughters. This method allows calculation of the concentrations in air of the daughter products of both ^{220}Rn and ^{222}Rn, based upon the radioactive decay of a sample. It employs observations of the total counts of alpha particles from the sample during various periods of time, rather than estimation of the counting rate at any particular time. There is no upper limit to the number of observations that may be used in the computations. Errors are estimated based upon the statistical limitations of the data. The method was tested on radon daughter samples taken in uranium mines under conditions both of equilibrium and extreme disequilibrium, and compared to the commonly employed Tsivoglou method. Filters were counted in the mines using a combination of ZnS phosphor, photomultiplier tube, and scalar. The concentrations of radium A, B, and C were calculated with both methods. The results of this comparison indicate major advantages of the new technique in research applications, including greater accuracy and clearly defined estimates of errors. (auth) (UK)

47392 ABOUT THE DETERMINATION OF URANIUM MICROQUANTITIES IN OILS ACCORDING TO TRACKS OF FISSION FRAGMENTS. Berzina, I. G.; Popenko, D. P.; Shimilevich, Yu. S. Geokhimiya, No. 8, 1024-7(Aug. 1969). (In Russian).

The fission track method is described for the determination of U in oils. The method enables the determination of concentration and space distribution in heavy fractions of oil, bitumen, and coal. (R.V.J.)

47393 SEMIQUANTITATIVE DETERMINATION OF THE ISOTOPIC COMPOSITION OF SAMPLES OF PLUTONIUM BY ALPHA SPECTROMETRY. Acena Barrenechea, M. L. (Junta de Energia Nuclear, Madrid). pp 133-42 of Traitement des Combustibles Irradies. Fontenay-aux-Roses, Centre d'Etudes Nucleaires, [1968]. (In Spanish).

From 1st Franco–Spanish Colloquium on the Processing of Irradiated Fuels, Fontenay-aux-Roses, France. See CONF-671143.

The necessity for knowing the specific alpha activity of different plutonium solutions that are used in the laboratory and the need for carrying out routine radiometric determinations led to the development of a method for determining the isotopic abundance of Pu with the aid of alpha spectrometry with semiconductors. The resolution of the procedure used does not permit differentiation between ^{239}Pu and ^{240}Pu; it is necessary to carry out first a quantitative determination of the plutonium contained in the sample in order to determine its absolute activity. Likewise, ^{241}Am is separated by ion exchange or extraction. Two spectra obtained from the two samples, one with Am and the other without, give sufficient data by measuring the areas under the two peaks, to determine the content of ^{239}Pu, ^{240}Pu, ^{238}Pu, and ^{241}Am. A study was made of the errors

made in these determinations, and the results obtained in several experiments are given. (tr-auth)

47394 PROCEDURE FOR THE DETERMINATION OF ^{210}Pb AND TOTAL LEAD IN BIOLOGICAL SAMPLES. Langford, J. C. (Battelle Memorial Inst., Richland, Wash.). Anal. Chem., 41: 1716(Oct, 1969).

A method for the determination of ^{210}Pb and total Pb in biological samples is presented that utilizes a diethylammonium diethyldithiocarbamate in chloroform extraction and, after wet ashing, an extraction of the lead iodide complex into hexone. The method has seven times greater sensitivity than other extraction procedures run by atomic absorption spectrometry. The chemical yield was determined with ^{212}Pb (10.6 hr) tracer. Total lead was measured by atomic absorption. The chemical yield as determined from standards in water solutions was 98 ± 3%. However, on 14 difficult biological samples, a yield of 70.5 ± 11% was obtained. As little as 5 μg of lead was measured at ±20% accuracy. (D.H.M.)

47395 IDENTIFICATION AND DETERMINATION OF VARIOUS URANIUM FISSION PRODUCTS AFTER REMOVAL FROM METAL SURFACES. I. Sorantin, H. (Oesterreichische Studiengesellschaft fuer Atomenergie GmbH, Seibersdorf, Austria). Mikrochim. Acta, No. 5, 925-50(1969). (In German).

In preliminary studies various reagents were tested for the removal of ^{131}I from platinum foils after treatment with pure ^{131}I or solutions of fission products. It was found that ^{131}I can be removed easily from platinum and likewise from super-refined steel by alkaline perhydrol solution. The same mixture can be employed to remove ^{131}I from the walls of irradiation containers after radiation experiments with test burner elements. Through subsequent determination of the ^{131}I it was possible to obtain approximate values for the deposition of the nuclide in the primary cycle of high temperature reactors. In the leachings, after chemical separation, it was possible in addition to identify the radionuclides ^{46}Sc, ^{51}Cr, ^{58}Co, ^{60}Co, ^{65}Zn, ^{110m}Ag, and ^{124}Sb as activation products, ^{137}Cs, ^{140}Ba, and ^{90}Sr as fission products, and ^{134}Cs as an activated fission product. Through subsequent etching with HNO_3–HF, it was demonstrated that by means of the alkaline procedure, the total ^{131}I but only a portion of uranium fission products that had deposited on the capsule walls could be removed, since no carrier could be added. (auth)

47396 RADIOCHEMICAL DETERMINATION OF URANIUM AND THE TRANSURANIUM ELEMENTS IN PROCESS SOLUTIONS AND ENVIRONMENTAL SAMPLES. Sill, Claude W.; Williams, Rodger L. (Health Services Lab., Idaho Falls, Idaho). Anal. Chem., 41: 1624-32(Oct, 1969).

A previous procedure for the separation and determination of uranium and the transuranium elements using barium sulfate has been improved greatly and applied to practical problems. By adding a more dilute barium solution dropwise to the sample solution at its boiling point, precipitation of the elements being carried was increased to a remarkable 99.995%, or a decontamination factor of 2×10^4 in a single precipitation. Ten pure solutions taken through the entire procedure including fusion, separation, and determination gave a relative standard deviation of 0.9%. The same changes also increased the permissible level of the worst interfering elements to about 1 mg, with most of the elements in the periodic table having been tested. The procedure was applied to many kinds of process solutions and environmental samples with excellent sensitivity, precision, and reliability. The radiochemical purity of all fractions is demonstrated by high-resolution alpha spectrometry. In addition, a procedure for the precise determination of gross alpha activity is presented and its use in complying with the summation rule for mixtures required by federal regulations is demonstrated. (auth)

47397 STUDIES OF THE CONTENT OF NATURAL RADIOISOTOPES IN SOME CHEMICAL REAGENTS. Przytycka, Roza; Olech, Barbara; Zukowski, Bogdan (Inst. for Nuclear Research, Warsaw). Nukleonika, 14: 391-5(1969). (In Polish).

The content of radium and thorium in some barium and calcium chemical reagents was studied. Radium and thorium were determined by the emanation method using scintillation flasks. The presence of radium, thorium, and their decay products was also established by α-microautoradiography. The content of radium was of the order of 10^{-12} to 10^{-13} Ci and of thorium of 10^{-13} Ci per gramme of the reagent. (auth)

47398 DETERMINATION OF MICROAMOUNTS OF ^{42}K IN THE PRESENCE OF MACROAMOUNTS OF ^{24}Na. Lada, Witold; Zelenay, Krystyna (Inst. for Nuclear Studies, Swierk, Poland). Nukleonika, 14: 387-90(1969). (In Polish).

Trace amounts of ^{42}K were determined in sodium carbonate targets irradiated with the aim to obtain a ^{24}Na activity. High voltage paper electrophoresis was applied to separate sodium and potassium. Their spectra were examined using a γ-ray spectrometer. Check runs with varying mass and activity ratios of sodium and potassium were performed in order to determine the resolution of the method. The contamination of the solution activity with ^{42}K activity was found to be not more than 0.001%. (auth)

47399 APPLICATION OF THE COULOMB BACKSCATTERING OF THE HEAVY CHARGED PARTICLES. II. CHEMICAL ANALYSIS OF SURFACE LAYERS. Turos, Andrzej Inst. of Nuclear Research, Swierk, Poland); Wilhelmi, Zdzislaw. Nukleonika, 14: 319-35(1969).

A nondestructive method for determining the chemical composition of surface layers has been developed, in which use is made of the phenomena occurring in backscattering of α particles and ^3He as well as of deuterons of energies 1 to 3 MeV. The accuracy of the method is about 5%, and the duration of the analysis 5 to 40 min. The sensitivity and resolution of the method are discussed and the possibilities of its application in various studies indicated. (auth)

47400 MOISTURE MEASUREMENTS IN VARIOUS MATERIALS BY PROTON RECOIL METHOD. Ivashchenko, G. A.; Starchik, L. F.; Tustanovskii, V. T. At. Energ. (USSR), 27: 233-4(Sept. 1969). (In Russian).

The moisture in various materials was determined by elastic scattering of fast neutrons on hydrogen nuclei. The equipment consisted of a block with a fast neutron source with a maximum energy of 10 to 11 MeV, a 6.6-cm-dia counter for recoil protons, and a photomultiplier. The sensitivity threshold for hydrogen was 0.006% at 10-sec exposure. The method can be used most effectively for moisture control of products with large cross sections for capturing thermal neutrons. (R.V.J.)

Activation Procedures

Refer also to abstracts 47729, 47785, and 49597.

47401 (CONF-691010–1) COMPARISONS OF NEUTRON ACTIVATION ANALYSIS AND SPARK SOURCE MASS SPECTROMETRY. Williamson, T. G.; Harrison, W. W. (Virginia Univ., Charlottesville). [1969]. 14p.

From 13th Conference on Analytical Chemistry in Nuclear Technology, Gatlinburg, Tenn.

Analysis of hair samples by spark-source mass spectrometry is shown to have certain advantages over neutron activation analysis. The number of elements that may be used to characterize each sample by SSMS is about twice the number that can be found by NAA. The accuracy is not quite as good, 20 to 30% as compared to about 10% achieved in this study and 3 to 5% claimed by some NAA workers. The time for analysis is much shorter by SSMS; a sample can be completely analyzed in a day whereas it takes one or two weeks of decay to obtain the results by NAA. On the other hand the SSMS requires more sample. To date the smallest hair samples analyzed were in the range 5 to 10 mg, whereas a single hair found at the scene of a crime may weigh less than a mg. The smaller specimens can be subjected to NAA. Lastly, of some importance to the forensic scientist, the SSMS is completely destructive but the sample is preserved for evidence in court when analyzed by NAA. For applications other than forensic, such as biological and clinical studies, in which the sample size is not a limit and in which it is not important to preserve the sample the spark source mass spectrometer has definite advantages, simply because of the larger number of elements that may be detected. (auth)

47402 (EUR–4287) RADIOCHEMICAL SEPARATION BY RETENTION ON IONIC PRECIPITATES. ADSORPTION TESTS ON 17 MATERIALS. Girardi, F.; Pietra, R.; Sabbioni, E. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). May 14, 1969. 100p. Dep. CFSTI (U. S. Sales Only).

The retention of different radio-ions on columns of seventeen ionic precipitates from different acid media was studied, in view of possible applications for radiochemical separations. The results of about 3,000 adsorption experiments, carried out in a standardized way, are presented schematically in periodic tables. Twenty-one radiochemical separations, mainly in connection with activation analysis problems, were done to test the practical behavior of potentially useful materials, and these are briefly described. (auth) (Euratom)

47403 CALCULATION OF THE EFFECT OF NONUNIFORM DISTRIBUTION OF MATTER ON ACTIVATION ANALYSIS WITH A NEUTRON GENERATOR. Sattarov, M. G.; Talanin, Yu. N.; Kryzhenkova, N. A. (Inst. of Nuclear Physics, Tashkent). Izv.

Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk, No. 1, 40-2(1969). (In Russian).

It was assumed that the sample and standard are right cylinders of radius r, that the flux varies inversely as the distance at small distances h, and that the small effect of self-shielding can be neglected. The average flux is defined for the interval h, and h_2. The induced activity is given for a homogeneous distribution of the component. In the general case the density distribution is unknown. Therefore partial cases are considered that take into account the volume ratios of the matrix components. For an arbitrary volume ratio an expression was derived for the correction coefficient, which gives the ratio of induced activities in the sample with homogeneous and inhomogeneous distribution of the component. The correction is substantial for very inhomogeneous distribution and high analysis accuracy. The effect of inhomogeneous distribution can be significantly lowered by taking the average of two activity measurements, and by changing the position of the irradiated sample by 180° with respect to the neutron source. (TTT)

47404 USE OF NEUTRON ACTIVATION ANALYSIS FOR DETERMINING THE CONTENT OF FLUORITE IN ORE CARTS. Porkopchik, V. I.; Bushkov, A. P.; Bernadskii, K. G. At. Energ. (USSR), 27: 161-3(Aug. 1969). (In Russian).

The fluorite content in an ore sample was estimated by counting the hard gamma radiation from ^{16}N(6.13 and 7.11 MeV), a short-lived radioisotope (half-life = 7.5 secs) which is formed as a result of an (n,alpha) reaction on ^{19}F. A Po–Be source with a flux of 1 to 2×10^7 neutrons/sec served as the source of fast neutrons. The ore in the ore cart was irradiated for a period of 60 seconds by immersing the neutron source in the powdered ore. The neutron source was withdrawn into a water-shielded tube, and a bank of 17 gas-discharge counters was moved into place to count the induced ^{16}N activity. The background was taken by counting again 40 to 60 seconds after the first measurement, when all the induced ^{16}N activity had decayed away. The average error of this express method of analysis was found to be 3.6% with deviations up to 7% in separate months. (TTT)

47405 NEUTRON ACTIVATION ANALYSIS OF NITROGEN IN FEEDSTUFFS. Doty, W. H. (Ralston Purina Co., St. Louis); Wood, D. E.; Schneider, E. L. J. Ass. Anal. Chem., 52: 953-6 (Sept. 1969).

The application of neutron activation analysis to the determination of nitrogen in various feeds and feedstuffs has been investigated. Samples were bombarded with fast neutrons to induce the $^{14}N(n,2n)^{13}N$ reaction. ^{13}N is a positron emitter with a 10 min half-life. The positrons annihilate in or near the sample to produce 0.51 MeV gamma rays, which are then counted in a detector system. Phosphorus and silicon interfere and are compensated for in the technique. A total of 419 individual runs were made on 53 samples covering 16 different types of materials. Total analysis time was 15 min per sample with a production rate of 12 samples per hr. The coefficient of variation of runs by the automated method typically ranged from 0.90 to 1.73 on the different sample groups. A good correlation between protein determined by the Kjeldahl technique and that determined by the automated method was demonstrated. (auth)

47406 ESTIMATION OF ANTIMONY IN HUMAN ENAMEL BY ACTIVATION ANALYSIS. Nixon, G. S.; Livingston, H. D.; Smith, H. (Univ. of Manchester, Eng. Univ. of Glasgow). Caries Res., 1: 327-32(1967).

The antimony content of the outer and inner layers of enamel from samples of human teeth was determined by a method of neutron activation analysis. The samples, weighing from 20 to 25 mg, were irradiated in a reactor for three days at a thermal neutron flux of 10^{12} n/cm²/s. The antimony activity was determined after a radiochemical separation by means of a Geiger counter. The samples analyzed were from the teeth of Scottish patients and also from Egyptian patients some of whom had received antimony injections in treatment of bilharziasis. No difference was found in the antimony content of the outer and inner enamel layers. The mean level of antimony found was 0.04 ppM and the range 0.005 to 0.67 ppM. (auth)

47407 NEUTRON ACTIVATION ANALYSIS OF SELENIUM IN BIOLOGICAL SAMPLES. Lambert, J. P. F.; Levander, O.; Argrett, L.; Simpson, R. E. (Food and Drug Administration, Washington, D. C.). J. Ass. Anal. Chem., 52: 915-17(Sept. 1969).

The selenium content in tissues of rats fed chronically toxic levels of selenium was determined by neutron activation analysis. The results were highly dependent on the value of the ^{77} Se half-life used in the computations. The best half-life value was selected by comparing results for different values of half-life with those from a colorimetric determination of identical samples. The neutron activation analysis method is rapid, nondestructive, and free of any chemical procedures. Selenium was determined at a 3 μg level with a counting error of ±6% at the 95% confidence level. (auth)

47408 NEUTRON ACTIVATION AND ATOMIC ABSORPTION ANALYSES OF CHEMICAL ELEMENTS IN SOIL. Brunelle, R. L.; Hoffman, C. M.; Snow, K. B.; Pro, M. J. (Internal Revenue, Washington, D. C.). J. Ass. Anal. Chem., 52: 911-14 (Sept. 1969).

Procedures are described for the determination of about 20 chemical elements in soil by NAA and AAA. It was found that the combination of these techniques is particularly suitable for soil analysis, because a large number of both major and minor elements can be determined with good precision and accuracy. Data are tabulated. (auth)

47409 QUANTITATIVE ESTIMATION OF V AND Ni IN CRUDE OIL, IN ITS FRACTIONS AND ASHES BY THE METHOD OF NEUTRON ACTIVATION. Lobanov, E. M.; Umarov, M. U.; Azizov, N. A.; Numanov, I. U. (Inst of Chemistry, Dushanbe, USSR). Dokl. Akad. Nauk Tadzh. SSR, 12: No. 6, 33-6(1969). (In Russian).

Determination of Ni and V in crude oil, its fractions, and ashes by neutron activation is described. The activity of the irradiated specimens was measured using a gamma scintillation spectrometer and results are tabulated. (R.V.J.)

47410 RADIOACTIVATION GAMMA SPECTRUM METHOD FOR DETERMINATION OF SOME ELEMENTS IN PLATES OF CRYSTALLINE QUARTZ. Lobanov, E. M.; Mamadzhanov, F. I.; Chubarov, L. B. (Inst. of Physics and Tech., Dushanbe, USSR. Inst. of Nuclear Physics, Tashkent). Dokl. Akad. Nauk Tadzh. SSR, 12: No. 6, 37-9(1969). (In Russian).

Descriptions are given of the neutron activation method for determining microimpurities in crystalline quartz plates. The specimens were irradiated in a vertical reactor channel with a neutron flux of 2×10^{13} n/cm² · sec for 10 hours. Trace amounts of Na, Ga, Cu, Fe, and Ag were found in the specimens examined. (R.V.J.)

47411 ACTIVATION AUTORADIOGRAPHIC DETERMINATION OF CARBON IN URANIUM NETWORK SUBSTRUCTURE. Bochvar, A. A.; Gruzin, P. L.; Tomson, G. I.; Babikova, Yu. F.; Kurochkin, Yu. Ya.; Minaev, V. M.; Petrov, Yu. I. At. Energ. (USSR), 27: 193-6(Sept. 1969). (In Russian).

Impurities forming the network substructure in uranium at the $\gamma \rightarrow \beta$ transformation were determined by activation autoradiography. It is shown that carbon in uranium is not uniformly distributed but is concentrated as a network in certain sites. This network is identical with that revealed in uranium by metallographic methods with proper etching. (auth)

47412 SELECTIVITY OF GAMMA-ACTIVATION ANALYSIS. Davydov, M. G.; Shcherbachenko, V. A. At. Energ. (USSR), 27: 205-8(Sept. 1969). (In Russian).

The problem of finding the best conditions for γ-activation analysis is considered by using the conception of selectivity that is defined by activation parameters of the sought for and interfering elements. The approximate expressions for activation parameters and selectivity are established. The proposed methods are illustrated by the calculation of the selectivity for the γ-activation analysis of gold in quartz. The best conditions of the analysis are $E_{\gamma m}$ = 8.5 MeV and a short cooling time. (auth)

47413 MULTIELEMENT NEUTRON ACTIVATION ANALYSIS OF ROCK USING CHEMICAL GROUP SEPARATIONS AND HIGH RESOLUTION GAMMA SPECTROMETRY. Morrison, G. H.; Gerard, J. T.; Travesi, A.; Currie, R. L.; Peterson, S. F.; Potter, N. M. (Cornell Univ., Ithaca, N. Y.). Anal. Chem., 41: 1633-7(Oct. 1969).

Instrumental neutron activation analysis and neutron activation analysis with a high-resolution lithium-drifted germanium detector, chemical group separations, and a coincidence-anticoincidence system were used to determine 45 elements in U. S. Geological Survey standard rock samples BCR-1, AGV-1, and G-2. U. S. Geological Survey standard rock W-1 was used as the standard. The principal nuclides, their γ rays used in the determinations, and the best time after irradiation for counting are listed. Nuclides are separated chemically into groups for counting by volatilization, extraction with hydrated antimony pentoxide, ion exchange, and solvent extraction with TBP. Agreement of the results with published data is good. (auth)

47414 ACTIVATION ANALYSIS WITH DEUTERONS. THE TOTAL CROSS SECTIONS OF THE REACTIONS $^{10}B(d,n)^{11}C$,

$^{14}N(d,n)^{15}O$, AND $^{16}O(d,n)^{17}F$ AT 3.2 MeV. Wohlleben, K.; Schuster, E. (Siemens AG, Erlangen, Ger.). Radiochim. Acta, 12: 75-9(Aug. 1969). (In German).

The reactions $^{10}B(d,n)^{11}C$, $^{14}N(d,n)^{15}O$, and $^{16}O(d,n)^{17}F$ are suitable for the activation analysis of boron, nitrogen, and oxygen. Using boron nitride and quartz respectively as standard, the total cross sections of these reactions were measured absolutely from 0.5 MeV (for the reactions on ^{10}B and ^{14}N) and from the threshold energy of 1.83 MeV (for the reaction on ^{16}O) to 3.2 MeV. At a deuteron energy of 3 MeV the theoretical detection limit is 3×10^{-10} g for boron, 5×10^{-11} g for nitrogen, and 4×10^{-11} g for oxygen. The half-life of ^{17}F was determined to be 65.2 ± 0.2 s. (auth)

47415 DETERMINATION OF FISSION PRODUCT ^{148}Nd FOR BURN-UP. Zelenay, T. (Inst. of Nuclear Research, Warsaw). Radiochem. Radioanal. Lett., 2: 33-40(Sept. 26, 1969).

A method is described for separating Nd from irradiated fuel by solvent and column extraction using DEHPA, and for determining ^{148}Nd by neutron activation. (auth)

47416 DETERMINATION OF THE IMPURITIES IN GeO_2, PRODUCED IN YUGOSLAVIA AND BY BDH, BY ACTIVATION ANALYSIS. Draskovic, R. J.; Kukoc, A.; Draskovic, R. S. (Boris Kidric Inst. of Nuclear Science, Vinca, Poland). Radiochim. Acta, 12: 69-72(Aug. 1969). (In French).

A method for the determination of impurities in GeO_2 by neutron activation analysis is described. A distillation method was used in order to separate the different impurities present in GeO_2. This method of analysis proved that GeO_2 produced in Jugoslavia and purified at Boris Kidrič Institute is of high purity. In the GeO_2 samples produced by BDH the following impurities were determined: Cu = 7.1×10^{-7} g/g of GeO_2 and Na = 4.0×10^{-5} g/g of GeO_2. (auth)

47417 NEW POSSIBILITY FOR THE METHOD OF ACTIVATION ANALYSIS OF URANIUM. Ikeda, Nagao; Kimura, Kan; Hasebe, Nobuyuki; Shoji, Hitoshi (Tokyo Kyoiku Univ.). Radiochim. Acta, 12: 72-5(Aug. 1969).

A simple method for the activation analysis of uranium is proposed. The nuclear reaction of $^{235}U(n,f)^{132}Te$ is utilized and the activity of ^{132}I in the radioactive equilibrium with ^{132}Te is measured. The method has the advantages that ^{132}Te is not a descendant of any rare gas nuclide and that the sensitivity is about twice as high as that for the ordinary $^{140}Ba-^{140}La$ method. (auth)

47418 METHOD OF ANALYSIS BY ACTIVATION OF ANCIENT COINS WITH FAST NEUTRONS. Tousset, J. (Univ., Lyon); Condamin, J.; Picon, M. Method. Phys. Anal., 4: 202-5(June 1968). (In French).

A method of analysis of ancient coins by activation with fast neutrons was devised for the major constituents, Cu, Ag, and Au. The composition is obtained by comparing the coin to be analyzed and a standard irradiated simultaneously. The ratio mass Ag/mass Cu was found by studying the decay curve of the 510-keV gamma resulting from the annihilation of the positrons emitted by ^{64}Cu and ^{198}Ag. The gold content is obtained from the activity of the 356-keV gamma emitted by ^{198}Au. The small cross sections allow self-screen effect variations between samples,and standards, important with thermal neutrons, to be considered as negligible. (auth)

Inorganic, Organic, and Physical Chemistry

Refer also to abstracts 47455, 47477, 47484, 47546, 47551, 47557, 47574, 47593, 47619, 47641, 48510, 48530, and 48540.

47419 (AD-690206) ISOTOPE EFFECT FOR THE DIFFUSION OF CADMIUM IN LEAD. Miller, J. Wesley; Edelstein, William A. (Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics). Mar. 1969. Contracts N00014-67-A-0298; Nonr-1866(56). 37p. (TR-20). CFSTI.

The experiment to determine the isotope effect for diffusion of Cd (109) and Cd (115m) in pure lead was performed as a critical test of the proposed interstitial-vacancy-pair mechanism of solute diffusion. The relative diffusivity of the two radioisotopes was determined, after sectioning, by counting with a thin NaI detector system, using energy discrimination. Stability and reproducibility of the count rates were tested and verified, an upper limit on the effect of crossover shown to be negligible, and a zero isotope effect experiment performed successfully. The isotope effect for the volume diffusion of cadmium in lead was determined to be (D (109)/D (115m) - 1) = 0.0032 at 248°C, corresponding to a solute correlation factor f = 0.12 for a mechanism involving single atomic jumps. It is then shown that this result, together with previous results for the solute and self-diffusivities D (0)2 and D (0)1 and the linear enhancement factor b11 for self-diffusion, are inconsistent with the simple vacancy, interstitial, interchange and ring mechanisms of solute diffusion, but agree with predictions of the model for solute diffusion by means of interstitial solute-vacancy pairs. The migration of associated vacancies results in a strong correlation of successive atomic jumps of bound interstitial solute atoms. (auth) (USGRDR)

47420 (BARC-385) ADSORPTION OF LONG CHAIN ELECTROLYTES AT THE SOLID-LIQUID INTERFACE. PART I. THE ADSORPTION OF MONAZITE-WATER SYSTEM. Viswanathan, K. V.; Shukla, S. K.; Majumdar, K. K. (Bhabha Atomic Research Centre, Bombay (India)). 1968. 22p. Dep. CFSTI (U. S. Sales Only).

The adsorption isotherms of dodecyl sulfate and dodecylamine acetate from aqueous solutions on monazite from two sources were determined. In these the effect of pH at a fixed detergent concentration was especially examined because an intersection of the cationic and anionic surfactant adsorption isotherms would give the approximate isoelectric point of monazite. Flotation studies were also carried out under the same conditions. The isoelectric point of monazite from these studies was found to be around pH 5.5 ± 0.5. This was further confirmed by studying the settling characteristics of the mineral at various pH. The adsorption isotherms were explained on the basis of the formation of hemimicelles. (auth)

47421 (CEA-R-3794) STUDY OF THE CATALYTIC ACTIVITY OF MIXED NON-STOICHIOMETRIC URANIUM-THORIUM OXIDES IN CARBON MONOXIDE OXIDATION. Brau, Guy (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). June 1969. 74p. (In French). Dep. CFSTI (U. S. Sales Only).

The catalytic properties of nonstoichiometric uranium oxides-thorium oxides having the general formula $U_xTh_{1-x}O_{2+y}$, for the oxidation of carbon monoxide were studied. The preparation of pure, homogeneous, isotropic solids having good structural stability and a surface area as high as possible calls for a strict control of the conditions of preparation of these oxides right from the preparation of "mother salts": the mixed oxalates $U_xTh_{1-x}(C_2O_4)_2 \cdot 2\,H_2O$. A study was made of their physicochemical properties (overall and surface chemical constitution, texture, structure, electric conductivity), as well as of their adsorption properties with respect to gaseous species occurring in the catalytic reactions. This analysis made it possible to put forward a reaction mechanism based on successive oxidations and reductions of the active surface by the reactants. A study of the reactions kinetics confirmed the existence of this oxidation-reduction mechanism, which occurs only for oxides having a uranium content of above 0.0014. The carbon dioxide produced by the reaction acts as an inhibitor by blocking the sites on which carbon monoxide can be adsorbed. These nonstoichiometric mixed oxides are a particularly clear example of catalysis by oxygen exchange between the solid and the gas phase. (auth)

47422 (EUR-2646(Pt.3)) THE RETENTION OF ORGANIC AND INORGANIC COMPOUNDS ON CLAY MINERALS. PART III. THE INTERACTION OF ATTAPULGUS CLAY AND HYDROGENATED POLYPHENYLIC NUCLEAR REACTOR COOLANT. Lopes Cardozo, R.; Van Velzen, D. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Apr. 24, 1969. 18p. Dep. CFSTI (U. S. Sales Only).

Following a study of the interaction of Attapulgus clay and polyphenylic reactor coolants, an investigation of the interaction of this clay material and hydrogenated polyphenylic reactor coolants was carried out. It is shown that the retention mechanism and the sorbate compounds are essentially the same in both cases. The reaction rate constant and the retention capacity of the clay with hydrogenated polyphenylic coolants are superior to the corresponding values for polyphenylic coolants. It is proved that Attapulgus clay catalyses cracking, polymerization, and isomerization reactions in nonirradiated, polyphenylic as well as hydrogenated polyphenylic coolants. In irradiated coolants, containing substantial amounts of high boilers and other decomposition products, these catalytic effects are greatly reduced, in some cases they are even negligible. (auth)

47423 (IS-RIC-2) 25 YEARS OF RARE EARTHS. A Bibliography of Rare-Earth Research Papers and Reports Published by the Ames Laboratory from Its Founding to Its 25th Anniversary. Smith, Joan E.; Bertrand, Charla C.; Gschneidner, Karl Jr. (Ames Lab., Iowa). Aug. 1968. 241p. Dep. CFSTI.

The references are grouped in the following sections: journals, conference proceedings, and books; reports (ISC and IS series);

theses; progress reports; and patents. Materials, subject, and author indexes are included. (M.C.G.)

47424 (ORO-3018-53) A PHYSICO-CHEMICAL STUDY OF SOME AREAS OF FUNDAMENTAL SIGNIFICANCE TO BIOPHYSICS. Annual Report, 1968–1969. McGlynn, S. P. (Louisiana State Univ., Baton Rouge). May 15, 1969. Contract AT(40-1)-3018. 24p. Dep. CFSTI.

A bibliography of twenty-five papers in which research is reported is included. Studies on the luminescence of the hydroxyl radical in various systems and the luminescence of simple nonaromatic carboxylic acids are reported. Studies on electronic states of inorganic oxyanions were initiated. Phosphorescence emission of ten nitrate salts in various media were observed. Phosphorescence spectra, excitation spectra, absorption spectra, and phosphorescence decay times were recorded for NaOCN, DOCN, $Cd(OCN)$, $Pb(OCN)_2$, $Hg(OCN)_2$, $Ag(OCN)$, CH_3NCO, CH_3CH_2NCO, and C_6H_5NCO. A discrepancy was noted between experimentally observed and calculated f-values in an effort to assign electronic transitions to molecules of ethylene and its alkyl substituted derivatives. Phosphorescence lifetimes of methylnaphthalene derivatives at 77 and 4.2°K are tabulated. A method was developed for the preparation of poly(methylmethacrylate). Luminescence emissions were observed for solid K_3CuCN_4 and $BaPt(CN_4)_4 \cdot 4H_2O$. (J.G.B.)

47425 (RFP-1339) CHEMISTRY IN NONAQUEOUS SOLVENT SYSTEMS. A TEN-YEAR ANNOTATED BIBLIOGRAPHY. Strickland, William R. (Dow Chemical Co., Golden, Colo. Rocky Flats Div.). Aug. 18, 1969. Contract AT(29-1)-1106. 17p. Dep. CFSTI.

The open literature for the past decade was surveyed for accounts of explorations in nonaqueous (organic) solvent systems. Those references pertinent to programs under consideration at Rocky Flats were tabulated and annotated. Subject and author indexes are included for the 138 references. (auth)

47426 TYAZHELEE URANA. (Heavier Than Uranium). Gol'danskii, V. I.; Polikanov, S. M. Moscow, Izdatel'stvo Nauka, 1969. 217p.

This book deals with the discovery, history, and physical and chemical properties of the transuranic elements: Np, Pu, Am, Cm, Bk, Cf, Es, Fm, Md, No, Lr, and element-104. General information on radioactive decay and contemporary ideas on nuclear fission are presented. A discussion is carried out on the experimental data determining the position of transuranic elements in the Periodic Table, and also, on data concerning the radioactive decay of various isotopes, from which it is possible to predict the radioactive properties of chemical elements which have not yet been synthesized. Special attention has been devoted to methods of synthesizing the super-heavy elements. These methods include target irradiation with intense neutron fluxes or with accelerated uranium nuclei. The very interesting hypothesis on the existence of a new region of transuranic elements with a relatively high stability is discussed. (TTT)

47427 REACTIVITY OF TRANSITION METAL FLUORIDES. VII. REACTIONS OF THE TETRAFLUORIDE, PENTAFLUORIDE, AND INTERMEDIATE FLUORIDES OF URANIUM. O'Donnell, T. A.; Wilson, P. W. (Univ. of Melbourne, Parkville, Australia). Aust. J. Chem., 22: 1877-82(Sept. 1969).

Selected oxidation–reduction and halogen–exchange reactions of the tetrafluoride, pentafluoride, and intermediate fluorides of uranium were investigated. (Australia)

47428 STRUCTURE OF Di-π-CYCLOOCTATETRAENE-URANIUM (URANOCENE). Zalkin, Allan; Raymond, Kenneth N. (Univ. of California, Berkeley). J. Amer. Chem. Soc., 91: 5667-8(Sept. 24, 1969).

Results of an x-ray diffraction study of a single crystal of di-π-cyclooctatetraeneuranium show that it is a pseudoaromatic ring and a π sandwich complex of the f5 transition series. The deep green compound crystallizes in $P2_1/n$ with a = 7.084, b = 8.701, c = 10.631 Å, β = 98.75, V = 6476 Å. The calculated density is 2.29 g/cm³. (D.H.M.)

47429 PROTON AND DEUTERON SPIN-LATTICE RELAXATION IN n-DODECANE. Woessner, D. E.; Snowden, B. S. Jr.; McKay, R. A.; Strom, E. Thomas (Mobil Research and Development Corp., Dallas). J. Magn. Resonance, 1: 105-18(Jan. 1969).

The spin-lattice relaxation rates of protonated and deuterated n-dodecane were measured neat and in various solutions of benzene, carbon tetrachloride, and carbon disulfide. An isotopic dilution technique, together with an automatic data acquisition system, provided a means for evaluating the inter- and intramolecular relaxation of protonated n-dodecane. The observed molecular rotational motions are to a first approximation, consistent with the Stokes–Einstein hydrodynamic model corrected for the particulate nature of the solvent by a microviscosity coefficient. (auth) (UK)

47430 ^{14}N NUCLEAR MAGNETIC RESONANCE OF SOME SOLID NITRATES. Whitehouse, B. A.; Ray, J. D.; Royer, D. J. (Georgia Inst. of Tech., Atlanta). J. Magn. Resonance, 1: 311-26(May 1969).

The equations of the "moment method" of Brown and Parker (Phys. Res. 100: 1764(1955)) were modified so that single crystals could be studied without prior knowledge of the orientation of the principal electric field gradient axes at the nuclei in question in the magnetic field. In addition, the equations could be applied to powdered substances. Single crystals of uranyl nitrate hexahydrate and rubidium nitrate were investigated by obtaining nuclear magnetic resonance spectra of the ^{14}N nuclei in these species. Nuclear electric quadrupole coupling constants and asymmetry parameters of the nitrogen nuclei, as well as the orientation of the nitrate groups with respect to the crystallographic axes, were determined. Interpretation of these results indicate that the structure of uranyl nitrate hexahydrate is that reported by Flemming and Lynton (Chem. Ind. (London) 1416(1900)) with slight modification of the nitrate positions. The results also show that the two crystal "habits" of rubidium uranyl nitrate are not different habits but are actually different crystal structures. Powdered samples of anhydrous zinc, cadmium, and mercuric nitrates were also investigated by ^{14}N NMR. The results indicate that the nitrates in zinc and mercuric nitrate are bidentate while in cadmium nitrate they are ionic or very nearly so. (auth) (UK)

47431 HIGH-PRESSURE Th_3P_4-TYPE POLYMORPHS OF RARE EARTH SESQUICHALCOGENIDES. Eatough, Norman L.; Webb, Alan W.; Hall, H. Tracy (Brigham Young Univ., Provo, Utah). Inorg. Chem., 8: 2069-71(Oct. 1969).

Th_3P_4-type polymorphs of the sesquisulfides of holmium, erbium, thulium, ytterbium, lutetium, and yttrium were made from the normal forms at 77 kbars and 2000°C. Holmium and erbium sesquiselenides of the Th_3P_4 type were formed from the elements at 68 kbars and 1800°C. (auth)

47432 NORMAL COORDINATE TREATMENT OF THE MOLECULES HNO_3 AND DNO_3 IN VAPOUR AND LIQUID STATES. Kumar, S. P.; Padma, V. A.; Rao, N. Rajeswara (Osmania Univ., Hyderabad, India). Indian J. Pure Appl. Phys., 7: 373-6(June 1969).

A method of determining the physically true force constants of molecules of HNO_3 and DNO_3 in liquid and vapor states is outlined, and the values were used to calculate the intensities of Raman lines following bond polarizability theory. The intensity and polarizability characters thus obtained are found to agree with experimental results. In the liquid state, contributions of Q_2 to $\langle D^2 \rangle$ and of Q_1 to $\langle d^2 \rangle$ increased, at the same time showing a small reduction in the amplitudes of their principal bonds d and D respectively, where Q_1 and Q_2 are the normal coordinates and D and d the lengths of the bonds N–OH and N=O. This can be described as mixing of the Q_1 and Q_2 modes in the case of NO_3 of D_{3h} symmetry and indicates that the formation of the hydrogen bond in the liquid state is driving the NO_3 group towards this symmetry. (auth)

47433 NIOBIUM: INTERMETALLIC PHASES. Ferro, R. (Univ., Catania, Italy). At. Energy Rev., Special Issue No. 2, 173-173-86(July 1968).

Data on niobium alloys are tabulated for: crystal system, space group, and structural type; unit cell dimensions (in Å); total number of atoms in the unit cell; and density (in g/cm³), both experimental and calculated. The alloys are arranged in alphabetical order. (136 references). (P.C.H.)

47434 NIOBIUM: COMPOUNDS WITH NON-METALS. Nowotny, H.; Seifert, K. (Univ., Vienna). At. Energy Rev., Special Issue No. 2, 71-172(July 1968).

Data on the crystal structures and densities and lattice spacings for niobium compounds with non-metals are tabulated. (267 references). (P.C.H.)

47435 NIOBIUM: PHASE DIAGRAMS. Feschotte, P. (Univ. of Lausanne, Switzerland); Livey, D. T.; von Goldbeck, O. At. Energy Rev., Special Issue No. 2, 45-69(July 1968).

A review is presented on the phase diagrams of Nb systems with Al, B, Be, C, Co, Ce, Cr, Cu, Fe, Ga, Hf, Ir, La, Mn, N, Ni, O, Pd, Pt, Re, Rh, Ru, Sb, Sn, Ta, Ti, U, V, W, Y, Zn, and Zr. (97 references). (P.C.H.)

47436 NIOBIUM: THERMOCHEMICAL PROPERTIES. Lavrentev, V. I.; Gerassimov, Ya. I. (Moscow Univ.). At. Energy Rev., Special Issue No. 2, 7-44(July 1968).

A review is presented on the thermodynamic properties of Nb. It is intended as a reference work for engineering and technical workers, scientists, and students at institutes of advanced education. The data available in the literature are critically reviewed, and recommendations for use are presented in tabular form. In all cases when actual processes of evaporation, sublimation, or chemical interaction are discussed, the calculations are made using the constant values of C_p of the corresponding process; this made it possible to describe most of the processes by trinomial equations. Equations for the temperature dependence of the heat capacity of Nb and its most important compounds are also given. (151 references). (P.C.H.)

47437 NIOBIUM: PHYSICO-CHEMICAL PROPERTIES OF ITS COMPOUNDS AND ALLOYS. At. Energy Rev., Special Issue No. 2, 1-202, (July 1968).

Five sections are included; separate abstracts were prepared for each one. (P.C.H.)

For abstracts of individual sections see: 47433–47436 and 48433.

47438 SYNTHESIS OF SINGLE CRYSTALS OF CERTAIN URANIUM OXIDES. Tsvigunov, A. N.; Kuz'micheva, E. U.; Kovba, L. M. Vestn. Mosk. Univ., Ser. II. Khim., No. 4, 116-17 (July-Aug. 1969). (In Russian).

Single crystals of α-U_3O_8, β-U_3O_8, U_8O_{21+x}, and U_4O_9 phase were prepared by the pyrolysis of the products of U_3O_8 chlorination. Lattice parameters of the compounds and symmetry group of β-U_3O_8 were determined. Unit cell dimensions of β-U_3O_8 were determined by x-ray study (a = 7.069 Å, b = 11.45 Å, c = 4.15 Å). Lattice parameters of α-U_3O_8 were in good agreement with previous data of others. (auth)

47439 ON THE ROLE OF HYDRODYNAMICS IN KINETICS OF ISOTOPIC EXCHANGE IN Sb(V)–HCl–$(C_4H_9)_2O$–H_2O SYSTEMS. Kireev, G. I.; Iofa, B. Z.; Abramov, A. A.; Nesmeyanov, A. N. Vestn. Mosk. Univ., Ser. II. Khim., No. 4, 82-4(July-Aug. 1969). (In Russian).

The effects of parameters of diffusion cells and mixers on the rate of isotopic exchange in Sb(V)–HCl–$(C_4H_9)_2O$–H_2O system have been investigated. Reynolds criterion considering parameters of the mixer and the cell was applied in the discussion on the experimental data. (auth)

47440 PHOTOCHEMICAL GENETICS. II. THE KINETIC ROLE OF WATER IN THE PHOTOHYDRATION OF URACIL AND 1,3-DIMETHYLURACIL. Burr, J. G.; Park, E. H. (North American Rockwell Corp., Thousand Oaks, Calif.). Advan. Chem. Ser., No. 81, 435-43(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.1).

The rate of photohydration of uracil with light of 265 n.m. in mixtures of acetonitrile and water is a linear function of the water content of the mixture; the deuterium isotope effect, R_{H_2O}/R_{D_2O}, is 1.18. These observations are shown to be consistent with the mechanism for uracil photohydrate formation proposed to explain the pH dependence of the rates. The rate of photohydrate formation for 1,3-dimethyluracil is approximately proportional to the square of the water concentration in acetonitrile–H_2O mixtures, acetonitrile–D_2O, and in dioxane–water mixtures, R_{H_2O}/R_{D_2O} = 2.84. These data are also interpretable in terms of a common photohydration mechanism. (auth)

47441 REACTION OF SOLUTIONS OF $(NH_4)_4[UO_2(CO_3)_3]$ WITH SYNTHETIC HYDROXYLAPATITE. Tarantsova, M. I.; Nikolskaya, Yu. P. (Inst. of Physico-Chemical Treatment of Mineral Resources, Novosibirsk, USSR). Izv. Sib. Otd. Akad. Nauk SSSR, No. 7, Ser. Khim. Nauk, No. 3, 82-6(May 1969). (In Russian).

The reactions of solutions of uranyl salts in the form of $[UO_2(CO_3)_3]^{4-}$-ion with synthetic hydroxylapatite have been studied. The chemisorptive character of the reaction has been demonstrated. (auth)

47442 INTERACTION OF OXIDES OF CERIUM SUBGROUP RARE-EARTH ELEMENTS WITH CALCIUM OXIDE. Lopato, L. M.; Lugin, L. I.; Gerasimyuk, G. I. (Inst. of Problems in Material Studies, Kiev). Dopov. Akad. Nauk Ukr. RSR, Ser. B, 6: 529-31(June 1969). (In Ukrainian).

The reactions of oxides of cerium subgroup rare earth elements with calcium oxide were investigated. It is established that La_2O_3 did not form compounds with CaO. The compounds of the $2Pe_2O_3 \cdot CaO$ composition were found in the systems where Pe = Pr, Nd, and Sm. The stability regions of the compounds and some of their physicochemical properties were determined. (auth)

47443 ELECTRONIC TRANSITIONS OF THE URANYL ION. Sanwal, D. N.; Pant, D. D. (Government Coll., Naini Tal, India). Proc. Indian Acad. Sci., Sect. A, 69: 324-37(June 1969).

A study was made of the absorption spectra of uranyl salts and solutions at room temperature and 80°K. Analysis of the results shows at least seven different transitions in the region 5000 to 1900 Å; the first five show a vibronic structure. Recent theoretical approaches are examined and an alternative point of view is presented in which the necessity of triplet states is ruled out. (D.L.C.)

47444 THE TEMPERATURE DEPENDENCE OF THE ISOTOPE EFFECT FOR ELECTROMIGRATION OF LITHIUM IONS IN MOLTEN LITHIUM NITRATE. Lunden, Arnold; Ekhed, Alf (Chalmers Univ. of Technology, Goteborg). Z. Naturforsch., 24a: 892-900(June 1969).

The relative difference ($\Delta b/b$) between the internal electromigration mobilities of ^6Li and ^7Li in molten $LiNO_3$ has been measured over the range 313 to 488°C. The mass effect, $\mu = (\Delta b/b)/(\Delta m/m)$, was found to be $-\mu = 0.0845 + (0.00002 \pm 0.00002)(t-300)$ where t is the temperature in °C and the quoted error is the standard deviation. There is thus in this case no significant influence of the temperature upon the mass effect. Some previous investigations of molten $LiNO_3$ gave smaller values for the mass effect. The reasons for these apparent discrepancies are discussed. A slight, but significant, anomalous enrichment of the light isotope was obtained in the middle of the cell, as has been previously observed in experiments with KNO_3. The mass effects have now been measured for all five alkali ions in the pure molten nitrates. For a corresponding temperature chosen 5% above the melting point none of the experimental values differ more than 14% from the relation $\mu_+ = -0.0848\,(1 + m_+/46)^{-1}$. The obtained relations were interpreted in terms of cooperative motion of the ions in a molten salt. (auth)

47445 ISOBARIC HEAT OF BORIC ACID. Popov, V. N.; Morozova, N. A. At. Energ. (USSR), 27: 233(Sept. 1969). (In Russian).

Experimental studies were made on the isobaric thermal capacity of aqueous solutions of boric acid at 20 to 270°C, 0 to 10 wt % concentrations, and 98 bars. (R.V.J.)

47446 ABSORPTION SPECTRA OF TRIVALENT URANIUM IN FUSED CHLORIDES. Poturaj-Gutniak, Stefan (Inst. of Nuclear Research, Warsaw). Nukleonika, 14: 269-74(1969).

The absorption spectra of trivalent uranium in NaCl–$AlCl_3$ and KCl–$AlCl_3$ melts were determined. Different absorption spectra were obtained for uranium (III) in molten salt solutions of the molar ratio Na(K)Cl/$AlCl_3$ > 1 and Na(K)Cl/$AlCl_3$ < 1. The effect of the surrounding ligands on the electronic transitions is discussed, and suggestions are given relative to the nature of environment of the uranium (III) central ion. (auth)

47447 RADIOCHEMICAL STUDY OF SELF-DIFFUSION AND ISOTOPE EXCHANGE IN AQUEOUS SOLUTIONS. PART VI. INVESTIGATION OF ISOTOPE EXCHANGE IN THE SYSTEM Tl/I/–Tl/III/ BY AN ELECTROLYTIC METHOD WITHOUT ANALYTICAL SEPARATION OF THE COMPONENTS. Gosman, A.; Sedlacek, J.; Broz, J. (Technical Univ., Prague). Radiochem. Radioanal. Lett., 2: 1-15(Sept. 26, 1969).

Experimental results of Tl(I)–Tl(III) isotope exchange investigation in 1.5m perchloric acid solution at 25°C are presented. The values of half-time exchange were determined by the method of simultaneous electrolytic deposition of both components on a single electrode. (auth)

47448 TARGET CHEMISTRY OF RUTHENIUM. Komura, Kazuhisa (Osaka Univ.); Mitsugashira, Toshiaki; Mito, Asae; Otozai, Kiyoteru. Bull. Inst. Chem. Res., Kyoto Univ., 47: 79-82(Mar. 1969).

The target chemistry of ruthenium concerning the measurement of the Ru(d,p) reaction cross sections was discussed. The uniform and firm metallic ruthenium was obtained by the electrodeposition from $RuNOCl_3$ solution. The bombarded target was dissolved in NaOH–Cl_2 solution. The solvent extraction by CCl_4 was successfully applied to separate ruthenium from rhodium and technetium. The back-extraction of ruthenium from the CCl_4 solution was carried out by 2N NH_4OH. Ruthenium was precipitated as sulfide, and used for counting source. It was found that the losses of ruthenium occurred in the procedures of the synthesis of $RuNOCl_3$, the electrodeposition of ruthenium, the dissolution of the target, and the preservation of the CCl_4 solution of ruthenium. Several devices were suggested to suppress the loss of ruthenium within the error of the cross section measured. (auth)

47449 ATLAS OF MASS SPECTRAL DATA. VOLUMES 1, 2, AND 3. Stenhagen, E.; Abrahamsson, S.; McLafferty, F. W.

(eds.). New York, John Wiley and Sons, Inc., 1969. 2569p. $150.00 (3 volumes).

Low-resolution mass spectra are given in three volumes: molecular weights 16.0313 to 142.0089 and molecular formulas CH_4 to $C_6H_6O_2S$; molecular weights 142.0185 to 213.2456 and formulas C_7H_7ClO to $C_{14}H_{31}N$; and molecular weights 213.8629 to 702.7981 and formulas $C_2H_4Br_2O$ to $C_{50}H_{102}$. (M.C.G.)

47450 POSSIBLE EXISTENCE OF DIVALENT AMERICIUM IN ACETONITRILE MEDIUM. Musikas, C.; Mjassoedov, B. (CEA, Fontenay-aux-Roses, France). Radiochem. Radioanal. Lett., 2: 21-6(Sept. 26, 1969). (In French).

The behavior of Am(III) and Pu(III) was studied polarographically in acetonitrile – 0.1M tetraethylammonium perchlorate medium. Two waves were observed in the Am(III) polarogram, the second one being twice as high as the first. Half-wave potential values are −1.65 and −2.0 V, respectively, vs the saturated calomel electrode. Only one wave was observed in the Pu(III) polarogram. The polarographic behavior of Am(III) was explained by the two steps reduction: $Am^{3+} + e \rightarrow Am^{2+}$ and $Am^{2+} + 2e \rightarrow Am/Hg$. (auth)

47451 STUDIES OF THE BEHAVIOR OF CARRIER-FREE RADIOISOTOPES. III. THE ADSORPTION CHARACTERISTICS OF EUROPIUM ON VARIOUS PLASTICS AND GLASS. Ichikawa, Fujio; Sato, Tadashi (Japan Atomic Energy Research Inst., Tokai). Radiochim. Acta, 12: 89-93(Aug. 1969).

The adsorption characteristics of carrier-free ^{155}Eu were described. The adsorption on the surfaces of several kinds of plastics and glass was studied in solutions with various pH values and with various electrolyte and europium concentrations. The maximum ionic adsorption of carrier-free ^{155}Eu on any kind of material tested was observed at pH 4.5. Another type of adsorption appeared at a pH value of about 9.5 with an increase in the concentration of sodium nitrate. The desorption behavior and autoradiographical studies were also described. The adsorption characteristics were compared with the centrifugal behavior of europium. (auth)

47452 PARTITION OF IODINE BETWEEN LIQUID SODIUM AND THE GAS PHASE AT 500°C. Clough, W. S. (United Kingdom Atomic Energy Authority, Harwell, Eng.). J. Nucl. Energy, 23: 495-503(Aug. 1969).

Iodine, labeled with ^{131}I, was added to high-purity sodium and the relative volatility measured at 500°C in distillation experiments. The effect of oxygen concentration in the sodium was measured over the range 1 to 10^4 ppM oxygen. The data at low oxygen concentration can be used to calculate the loss of fission product iodine from the sodium blanket in the case of fuel can failure, core melt down without breaching of the sodium containment, or uncanned fuel operation. The data at high oxygen concentration apply to the case of partial oxidation of the sodium, e.g., due to a sodium fire. The effect of iodine concentration on the relative volatility of the iodine and the sodium was measured in the concentration range 10^{-3} to 10^2 ppM of iodine. The effect of increasing the iodine concentration is to decrease the volatility of iodine relative to that of sodium. At the highest iodine concentration studied the iodine is approximately 30% less volatile than at the lowest iodine concentration levels. (auth) (UK)

47453 VIBRATIONAL SPECTRA OF THE $[UO_2Cl_4]^{2-}$ AND THE $[UO_2Br_4]^{2-}$ IONS. Newbery, J. E. (Kent Univ., Canterbury, Eng.). Spectrochim. Acta, Part A, 25: 1699-1702(Oct. 1969).

Raman and infrared spectra of $[UO_2Cl_4]^{2-}$ and $[UO_2Br_4]^{2-}$ were obtained from alkali metal and alkylammonium salts in the solid state. The fundamentals are assigned in terms of the point group D_{4h}. Dissolution of the salts in dilute hydrohalic acids leads to displacement of the halide ions by water molecules. (auth) (UK)

Radiation and Nuclear Chemistry

Refer also to abstracts 47440, 47590, 47610, 47713, 47849, 47953, 47954, 48583, 48698, 48741, 48745, and 48979.

47454 (AE-368) SCANDINAVIAN RADIATION CHEMISTRY MEETING, STUDSVIK AND STOCKHOLM, SEPTEMBER 17-19, 1969. Christensen, H. (ed.) (Aktiebolaget Atomenergi, Studsvik (Sweden)). Aug. 1969. 36p. (CONF-690913-(Absts.)). Dep. CFSTI (U. S. Sales Only).

Abstracts are given of 25 papers presented at the meeting. The following subjects are dealt with: pulse radiolysis, water and aqueous solutions including water vapor, inorganic systems, organic systems, monomers and polymers, and biochemical systems. (Sweden)

47455 (CALT-767-P-4-54) STUDIES IN CHEMICAL DYNAMICS AND RADIATION CHEMISTRY. Technical Progress Report, July 1, 1968–June 30, 1969. Kuppermann, Aron (California Inst. of Tech., Pasadena). July 1, 1969. Contract AT-(04-3)-767. 35p. Dep. CFSTI.

Research progress is reported on: low-energy electron scattering, photoelectron spectrometry, elementary reactions by photolysis at various wavelengths, collisions in crossed molecular beams, and theory of chemical reactions. (M.C.G.)

47456 (COO-38-641) BIBLIOGRAPHY ON THE RADIATION CHEMISTRY OF AQUEOUS SOLUTIONS. I. AMINO ACIDS. (Notre Dame Univ., Ind. Radiation Lab.). Nov. 25, 1968. Revised Aug. 1969. 18p. Dep. CFSTI.

One hundred and sixty-five references listed by year and alphabetically by first author within each year are given. (M.C.G.)

47457 (COO-690-34) RADIATION EFFECTS IN BIOCHEMISTRY AND ORGANIC CHEMISTRY. Technical Progress Report, October 15, 1968–October 14, 1969. (Colorado Univ., Boulder). Contract AT(11-1)-690. 52p. Dep. CFSTI.

Research is reported in seven sections. Separate abstracts were prepared for five sections. The other sections cover, very briefly, experimental concepts for protein irradiation studies and protein association of aspartate transcarbamylase. (M.C.G.)

For abstracts of individual sections see: 47458–47462.

47458 (COO-690-34, Sect. 2) DISTRIBUTION OF TRITIUM IN CHROMATOGRAPHIC FRACTIONS AFTER HTS TREATMENT OF IRRADIATED LYSOZYME. NATURE OF THE "NATIVE PEAK" OBTAINED BY CHROMATOGRAPHY OF IRRADIATED LYSOZYME. Herbert, Sarah M. (Colorado Univ., Boulder). 14p.

Anion exchange column chromatography of irradiated lysozyme treated with HTS (tritiated hydrogen sulfide) shows that all peaks are labeled approximately equally. This indicates extensive and comparable damage to all molecules. The damage does not correlate with loss of enzymic activity. The major chromatographic peak after irradiation corresponds to native enzyme but many of its physical properties are altered, including solubility, heat denaturation, uv spectra, and ORD. These data indicate that essentially all lysozyme molecules have suffered severe damage after irradiation at the D_{50} level. Such facts do not support the classical hit theory of radiation inactivation of proteins. (auth)

47459 (COO-690-34, Sect. 3) SOLUBILITY CHARACTERISTICS OF GAMMA IRRADIATED LYSOZYME. Marciani, Dante W. (Colorado Univ., Boulder). 8p.

Vials containing dry lysozyme were irradiated in a ^{137}Cs γ source at 0.388 Mrads/hr to a total dose of 45.8 Mrads. The vials were then broken below oxygen-free water to obtain a solution of the irradiated protein. Data on the precipitation of protein from the aqueous solutions are given. (M.C.G.)

47460 (COO-690-34, Sect. 4) PHYSICAL AND CHEMICAL PROPERTIES OF IRRADIATED LYSOZYME. Marciani, Dante W.; Tolbert, Bert M. (Colorado Univ., Boulder). 17p.

Data are presented on the D_{37} value for γ-irradiated crystalline lysozyme assayed at different pH and on the effects of temperature on the lysis of Micrococcus lysodeikticus by γ-irradiated lysozyme. The lytic activity of lysozyme irradiated at doses between 0 and 60 Mrads was lost at different rates, depending on the pH at which the assays were made. The inactivation curves followed the logarithmic relationship in the dose range studied. The pH optimum depended on the composition of the buffer solution, concentration of NaCl, and on the method used for assay. (M.C.G.)

47461 (COO-690-34, Sect. 5) CHEMICAL AND CONFORMATIONAL STUDIES OF GAMMA IRRADIATED LYSOZYME. Marciani, Dante W.; Herbert, Sarah M.; Tolbert, Bert M. (Colorado Univ., Boulder. Dept. of Chemistry). 14p.

Detailed chemical effects of gamma radiation on dry, solid lysozyme were measured. Solubility, pH profile, activation energy, and ammonia yields were measured as a function of radiation. Chromatographic behavior after HTS (tritiated hydrogen sulfide) treatment was determined. These parameters suggest that at the D_{37} value most lysozyme molecules suffer severe chemical damage. A theory of radiation in activation is proposed based on an independent cumulative inactivation of amino acid residues related to the active site. This theory is used to calculate a $G_{inactivation}$ value for ribonuclease and lysozyme. (auth)

47462 (COO-690-34, Sect. 6) CHITIN COLUMN CHROMATOGRAPHY OF IRRADIATED LYSOZYME. Marciani, Dante W. (Colorado Univ., Boulder). 5p.

Column chromatography of irradiated lysozyme was carried out using chitin as the support material. Data are presented in graphs. (M.C.G.)

47463 (COO-1088-37) THE RADIATION CHEMISTRY OF HIGH POLYMERS. Final Report. Dole, Malcolm (Northwestern Univ., Evanston, Ill. Dept. of Chemistry). Sept. 1969. Contract AT(11-1)-1088. 17p. Dep. CFSTI.

The fate of alkyl free radicals that survive in polyethylene on heating to room temperature after irradiation at 77°K is discussed. Evidence indicates that these surviving radicals convert to allyl free radicals at room temperature and to nothing else. The radiation chemistry of polypropylene and polypropylene oxide was also studied. (M.C.G.)

47464 (ORNL-4373) RADIATION-INDUCED REACTIONS OF SOME FURAN CHEMICALS. Myron, J. J. J.; Parkinson, W. W. (Oak Ridge National Lab., Tenn.). Aug. 1969. Contract W-7405-eng-26. 25p. Dep. CFSTI.

The products of irradiating tetrahydrofuran, furfural, tetrahydrofurfuryl alcohol, and dimethyl sulfoxide, individually and in mixtures, have been investigated for commercial potential. Solutions of pentadiene in furfuryl alcohol, in tetrahydrofurfuryl alcohol, and in furfural have been irradiated and examined more briefly. In tetrahydrofuran and dimethyl sulfoxide only products observed in the desirable molecular weight range of dimers and trimers were observed. In these cases the yields were not over 5 molecules per 100 eV, inadequate for commercial exploitation. The major radiation product from furfural was a complex polymer at the rate of 4 molecules of furfural incorporated per 100 eV. A considerably higher polymer yield, probably about 13 molecules incorporated per 100 eV was observed in solutions of pentadiene in furfuryl alcohol. (auth)

47465 (ORO-2968-49) RESEARCH CONCERNING IONIC AND FREE RADICAL REACTIONS IN RADIATION CHEMISTRY. Progress Report, September 15, 1968-September 15, 1969. Williams, T. Ffrancon (Tennessee Univ., Knoxville. Dept. of Chemistry). Contract AT(40-1)-2968. 11p. Dep. CFSTI.

Structural and chemical investigations are proceeding on dipole-trapped electrons in crystalline organic cyanides. Thermal decay rates of trapped electrons in 3-methylpentane glasses were studied. Intermediates in irradiated organic glasses and trapped electrons in polymers are discussed. Mechanisms of radioinduced polymerization are considered. The molecular weight distribution of polyisobutylene was determined as a function of irradiation temperature. ENDOR and ELDOR studies are being made of trapped electrons. (M.C.G.)

47466 (RFP-1376) RADIATION CHEMISTRY OF MATERIALS USED IN PLUTONIUM PROCESSING. Kazanjian, Armen R.; Brown, Alan K. (Dow Chemical Co., Golden, Colo. Rocky Flats Div.). Sept. 4, 1969. Contract AT(29-1)-1106. 16p. Dep. CFSTI.

There are many materials used in plutonium fabrication that are highly susceptible to radiolytic decomposition. The radiation chemistry of those materials used at Rocky Flats is summarized. The radiolysis products are, in general, reactive toward plutonium and could lead to corrosion. However, the extent of radiation damage depends on the exposure conditions. (auth)

47467 (UCRL-Trans-10376) EFFECT OF γ RADIATION ON THE DIELECTRIC AND MECHANICAL PROPERTIES OF POLYMETHYL METHACRYLATE AND POLYPROPYLENE. Sauerbrey, H.; Suhr, H. Translated by R. Dewar for Univ. of California, Lawrence Radiation Lab., Livermore, from Kolloid-Z. Z. Polym., 225: 121-24(Aug. 1968). 8p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 23: 17487. (auth)

47468 INFRARED SPECTROSCOPIC METHOD OF STUDYING THE CHANGE IN TYPE OF BONDING IN THE SULFATE ION OF RADIOACTIVE SULFATES OF A NUMBER OF ELEMENTS OF GROUPS I AND II OF THE PERIODIC TABLE. Spitsyn, Vikt. I.; Mikhailenko, I. E.; Morozova, T. V. (Inst. of Physical Chemistry, Moscow). Dokl. Akad. Nauk SSSR, 186: No. 4, 870-3(1969). (In Russian).

Radioactive and nonradioactive sulfates Li_2SO_4, Na_2SO_4, K_2SO_4, $MgSO_4$, and $BaSO_4$ were synthesized under the same conditions. The maximum dose from the 0.167-MeV beta particles of ^{35}S (half-life = 87.1 days) was varied from 2.3×10^{21} to 4.8×10^{22} eV/g. Samples were suspended in isobutyl alcohol or in vaseline, and were subjected to infrared spectroscopy at a temperature of 25°C. Electron excitation, atomic ionization, and displacement of an atom to an internodal point can take place under the effect of beta irradiation. Thus a change in the symmetry of the electric force field of the crystal lattice was observed in the splitting of absorption bands in Li_2SO_4, Na_2SO_4, K_2SO_4, and $MgSO_4$. The local symmetry was decreased. The stronger the crystal lattice as indicated by the melting point, the smaller was the observed effect of the beta radiation. The effects of beta radiation on barium sulfate with a melting point of 1580°C was slight compared to the effects of radiation on lithium sulfate with a melting point of 860°C. The method gives valuable information on changes in types of bonding and lattice defects arising from irradiation. (TTT)

47469 UNSTABLE INTERMEDIATES. PART 62. ELECTRON SPIN RESONANCE STUDIES OF HYPERCONJUGATION IN THE RADICALS H_2CN AND $(CH_3)_3N^+$. Brivati, J. A.; Root, K. D. J.; Symons, M. C. R.; Tinling, D. J. A. (Univ. of Leicester, Eng.). J. Chem. Soc., A, No. 13, 1942-5(1969).

The spin density distributions in the radicals H_2CN and $(CH_3)_3N^+$ are estimated from ESR spectra and interpreted in terms of hyperconjugation. A comparison is made with the distributions in the related HCN^-, HCO, and alkyl radicals. H_2CN was produced by γ irradiation at room temperature of cyanide-doped potassium chloride crystals and $(CH_3)_3N^+$ was prepared in betaine hydrochloride, $[(CH_3)_3N^+CH_2CO_2H]Cl^-$ by γ irradiation of finely powdered material at room temperature. (UK)

47470 THE CONVERSION OF Cu^{2+} TO Cu^+ DUE TO RADIATION DAMAGE IN COPPER ACETATE MONOHYDRATE. Apaydin, F.; Clough, S. (Univ. of Nottingham, Eng.). J. Phys., C (London), 2: 1536-7(Aug. 1969).

The electron spin resonance spectrum of magnetically isolated Cu^{2+} ions was studied in γ-irradiated copper acetate monohydrate, which when undamaged contains only exchange-coupled pairs of Cu^{2+} ions. It is proposed that a liberated hydrogen atom converts a water molecule to H_3O^+, donating an electron to the nearby Cu^{2+} ion. (auth) (UK)

47471 UNSTABLE INTERMEDIATES. PART 63. RADICAL ANION AlH_3^- IN γ-IRRADIATED ALUMINUM HYDRIDES. Catton, R. C.; Symons, M. C. R. (Univ. of Leicester, Eng.). J. Chem. Soc., A, No. 13, 2001-2(1969).

After exposure to γ irradiation at 77°K, lithium and sodium aluminium hydride and deuteride gave ESR spectra consisting of six broad hyperfine features characteristic of the ^{27}Al nucleus. The magnitude of the isotropic coupling (ca 223 G) and of the anisotropic coupling (ca 30 G) were close to those expected for pyramidal molecules having bond angles ca 110° and the unpaired electron strongly confined to aluminium. Any hyperfine coupling to the protons must be < ±20 gauss. (auth) (UK)

47472 SYNTHESIS OF AMINO ACIDS BY PROTON IRRADIATION OF GASEOUS MIXTURES WITH AMMONIA AND ELEMENTARY NITROGEN. Vinogradov, A. P.; Vdovykin, G. P. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Geokhimiya, No. 9, 1035-8(Sept. 1969). (In Russian).

During irradiation by 600-MeV protons (integral flux 5.4×10^{14} protons/cm^2) of six initial mixtures of simple compounds with different nitrogen and carbon forms (CH_4, CO_2, CO, C, NH_3, N_2, NH_4^+, Cl^-, S_2 in the presence of H_2O) the amino acids, glycine, alanine, glutamic acid, asparagine, lysine, histidine, valine, and leucine, were synthesized. Amino acids were formed independently of the initial nitrogen form, both in experiments with ammonia and in experiments with elementary nitrogen. However, in the experiments with nitrogen in the form of ammonia a greater yield of amino acids was observed. (auth)

47473 RADIOLYSIS OF GASEOUS ISOBUTYLENE BY ^{60}Co γ-RAYS. II. IRRADIATION OF ISOTOPIC MIXTURES: iso-C_4H_8 + iso-C_4D_8. Herman, J. A.; Collin, G. (Laval Univ., Quebec). Can. J. Chem., 47: 3837-44(Oct. 15, 1969).

The radiolysis of the isotopic mixture: iso-C_4H_8 + iso-C_4D_8 shows that, at 48 Torr pressure, about 40% of isobutane is formed in an ion–molecule reaction between isobutyl ion and the monomer. Half of the propene produced in radiolysis is formed in ion–molecule reactions, the H^- transfer reaction to $C_3H_5^+$ ion being the most important process. Small fractions of CH_4, C_2H_2, C_2H_4, allene, and propyne are also formed in ionic processes, but the main part results from unimolecular decomposition processes of the excited isobutylene. (auth) (Canada)

47474 RADIATION CHEMISTRY OF LIQUID METHYLAMINE. Smithies, D.; Whitworth, A. J. (Univ. of Leeds, Eng.). J. Chem. Soc., A, No. 13, 1987-1990(1969).

Liquid methylamine was decomposed by γ rays to give hydrogen, methane, ethylenediamine, and azomethane with yields of 5.4, 0.18, 3.4, and 0.7 molecules per 100 eV respectively. The effects of solutes sodium nitrate, silver perchlorate, chloroform, propene, benzene, naphthalene, carbon tetrachloride, acetone, and nitrous oxide on the yields of hydrogen were interpreted in terms of scavenging of e^-_{sol} and/or H atoms. On the basis of an assumed mechanism the data give $G_{e^-(sol)} = 3.2 \pm 0.2$ and $G_H = 1.6 \pm 0.3$. (auth) (UK)

47475 GAS PHASE RADIOLYSIS OF HYDROGEN CHLORIDE, HYDROGEN BROMIDE, AND NITROUS OXIDE WITH INTENSE ELECTRON PULSES. Willis, C. (Atomic Energy of Canada, Chalk River, Ont.); Boyd, A. W.; Armstrong, D. A. Can J. Chem., 47: 3783-91(Oct. 15, 1969). (AECL-3399).

Hydrogen chloride and hydrogen bromide were irradiated with single electron pulses at a very high intensity (10^{27} eV g^{-1} s^{-1}) with a Febetron 705. At room temperature the yields of hydrogen from hydrogen chloride and hydrogen bromide, for pressures between 700 and 1200 Torr, are $G(H_2) = 8.1 \pm 0.2$ and $G(H_2) = 9.9 \pm 0.3$, respectively. These are the same as the yields observed at low dose rates. Detailed lifetime calculations, however, show that the mechanism is significantly different at the higher dose rate. Scavenger experiments with chlorine in hydrogen chloride show that the negative ion intermediates form thermal hydrogen atoms. The value of $G(N_2) = 12.4 \pm 0.2$ from nitrous oxide at a dose rate of 10^{27} eV g^{-1} s^{-1} is confirmed and the use of nitrous oxide as a dosimeter for pulsed electron beams is discussed. The higher nitrogen yield at Febetron dose rates appears to be due to changes in the reactions of electrons. (auth) (Canada)

47476 RADIOLYSIS OF AQUEOUS SOLUTIONS OF PHENYLALANINE OR TYROSINE WITH VARIOUS ADDITIVES. Brodskaya, G. A. At. Energ. (USSR), 27: 150-2(Aug. 1969). (In Russian).

Solutions containing 0.01 to 0.05M glycine and 0.01 to 0.05M tyrosine or phenylalanine were subjected to a ^{60}Co, gamma dose of 0.5 to 50 megarads at a temperature of 35 to 37°C. The solutions were put under vacuum, and were saturated with nitrogen or oxygen. The results showed that the addition of the aromatic aminoacid to the glycine solution significantly decreases the radiolytic decomposition of the glycine. The overall deamination in the system is reduced. The effects of adding the aromatic aminoacid increase with increasing concentration of the additive and with increasing irradiation dose. The presence of oxygen in solution decreases the effect of the additive somewhat. The aromatic aminoacid in a mixture decomposes to a greater extent than it does in its own individual solution without glycine being present, as shown by absorption spectra. This protective effect of glycine may be caused by the formation of a reactive radical formed from glycine. (TTT)

47477 ENTHALPY OF FUSION OF IRRADIATED POLYETHYLENE CRYSTALS. Rijke, A. M.; Mandelkern, L. (Florida State Univ., Tallahassee). J. Polym. Sci., Part B, 7: 651-6 (Sept. 1969).

Some interesting changes in the enthalpy of fusion of resulting systems were observed during the course of studying the effects of temperature, molecular weight, and level of crystallinity on the irradiation crosslinking of linear polyethylene. As a result, studies were made on the dependence of the enthalpy of fusion on the irradiation dose for fractions of linear polyethylene that initially are in a highly crystalline state. From the results it was found that the enthalpy of fusion, ΔH^*, values drop sharply with the initial amount of irradiation until a minimum value is reached. The enthalpy of fusion then increased with further dosage and eventually leveled off. The constant value that was attained at high dosages was just slightly less than the value characteristic of the unirradiated sample. The same effects were observed for a higher irradiation temperature as long as the crystalline state was maintained. The only major difference in these two cases was that the dosage corresponding to the minima was less for the 100° irradiation. It was concluded that irradiation affected the thermodynamic properties of the system and thus the course of fusion. (P.C.H.)

47478 EFFECT OF SURFACE CONCENTRATION ON THE RADIATION POLYMERIZATION OF ADSORBED FURAN MOLECULES. Livingston, H. K.; Senkus, Raymond (Wayne State Univ., Detroit). J. Polym. Sci., Part B, 7: 635-41(Sept. 1969).

The radioinduced polymerization of furan molecules adsorbed on Graphon carbon black was studied using γ and x radiation. It was found that for reproducible polymerization to take place no more than a monolayer of furan can be present. The results also indicated that the cationic mechanism is not the mechanism of the polymerization on the Graphon surface. Thus, the orienting effect of the solid surface resulted in a polymer with a different structure than the bulk polymer that is readily formed with cationic initiators. (P.C.H.)

47479 γ RADIOLYSIS OF LIQUIDS AT HIGH PRESSURES. VII. OXIDATION OF IODIDE ION BY HYDROGEN ATOMS IN AQUEOUS SOLUTIONS. Hentz, Robert R.; Johnson, Clarence G. Jr. (Univ. of Notre Dame, Ind.). J. Chem. Phys., 51: 1236-41(Aug. 1, 1969). (COO-38-660).

The H-atom oxidation of iodide, $H + H^+ + I^- \rightarrow H_2 + I$, [1] was studied in the γ radiolysis of deaerated acidic iodide solutions at 20° and applied pressures in the range 0 to 6.38 kbar. Without added iodine, slopes of dose plots for $[H_2]$ and total iodine, $[I_2]_t \equiv [I_2] + [I_3^-]$, begin to decrease appreciably at relatively low doses and approach limiting values at high doses. Such behavior is a consequence of the reaction $H + I_3^-$ (or I_2) $\rightarrow H^+ + I^- + I_2^-$ (or I), [2], for which $k_2 = 3.0 \times 10^{10}$ $M^{-1} \cdot sec^{-1}$ was measured in solutions containing glucose and iodine with $[I_3^-] \geq 0.83\ [I_2]_t$. In solutions without added iodine, results were consistent with the established model for water radiolysis and with the previously established pressure independence of primary yields (g): at all doses $[H_2] = [I_2]_t$; from initial slopes at both 1 atm and 6.38 kbar, $G(I_2)_t = 4.1 = g(H_2) + g(H)$; from the high-dose limiting slope at 1 atm, $G(I_2)_t = 0.45 \approx g(H_2)$. Competition between Reactions [1] and [2] was studied by measurement of initial H_2 yields from solutions with added iodine. Reaction [2] was assumed diffusion controlled with $\Delta V_2^{\ddagger} = 1.6$ ml mole^{-1}. For $[I^-]$ up to at least 0.6M and $[H_2SO_4]$ up to at least 0.8N, rate of Reaction [1] at all pressures is given by $k_1[H][I^-][H^+]_t$, in which $[H^+]_t \equiv [H^+] + [HSO_4^-]$; i.e., HSO_4^- was indistinguishable from H^+. Reaction [1] occurred in termolecular encounters via $H + I^- \rightarrow (HI^-)^{\ddagger}$ followed by proton transfer from the acid ion present. At 1 atm, $k_1 = 5.3 \times 10^8$ $M^{-2} \cdot sec^{-1}$ and $\Delta V_1^{\ddagger} \approx -11$ ml mole^{-1}; $\Delta V_1^{\ddagger} = -6.3$ ml mole^{-1} for P in the range 2-6.4 kbar. (auth)

47480 NUCLEAR CHEMISTRY RESEARCH WITHIN AKTIEBOLAGET ATOMENERGI. Carleson, Goeran; Oesterlundh, Carl Gustaf. Mod. Kemi, 2, No. 6, 26-31(1969). (In Swedish).

A review is given of the nuclear chemistry research performed within Aktiebolaget Atomenergi. Studies on isotopes enrichment, reactor chemistry, plutonium, radiation chemistry, and radioactive isotopes are briefly described. (Sweden)

47481 ELECTRON SPIN RESONANCE OF RADICAL PAIRS IN X-IRRADIATED CLATHRATE COMPOUNDS OF HYDROQUINONE. Ohigashi, Hiroji; Kurita, Yukio (Toyo Rayon Co., Ltd., Kamakura, Japan). J. Magn. Resonance, 1: 464-78(July 1969).

Electron spin resonance spectra of the x irradiated clathrate compounds of hydroquinone with acetonitrile, sulfur dioxide, carbon dioxide, hydrogen chloride, methanol, and formic acid were studied at liquid nitrogen temperature. An ESR absorption spectrum due to a paramagnetic species in a triplet state was observed in each of these clathrate compounds. The analysis of angular dependence of the spectra for the complexes with acetonitrile and sulfur dioxide showed that this magnetic species is attributable to pairwise trapping of two p-hydroxyphenoxyl radicals about 5 Å apart, an exchange interaction between them being responsible for the triplet state. An anomalous angular dependence of a spin-lattice relaxation time was observed in the hydroquinone-acetonitrile clathrate compound. Cyanomethyl radicals were produced in the crystals of the hydroquinone-acetonitrile clathrate compound irradiated at low temperature and subsequently annealed at 190°K. These radicals undergo rapid rotational motion around the C-C bond parallel to the c axis of the hexagonal crystal even at 77°K. (auth) (UK)

47482 AN EFFICIENT AND HIGHLY SELECTIVE RADIATION-INDUCED ISOMERIZATION IN THE CRYSTALLINE STATE. Walker, David C. (Univ. of British Columbia, Vancouver). J. Phys. Chem., 72: 3772-4(Oct. 1968).

An evaluation and discussion of the G value for a remarkable radiation-induced isomeric transformation of a crystalline organic esten (P-bromophenacyl ester of hirsutic acid) during x-ray crystallographic analysis. The high yield [G(isom) > 57] cannot result from a chain reaction but appears to be a real case of extremely efficient energy transfer or collective excitation peculiar to the pure crystalline state. (auth)

47483 HIGHER ORDER ION-MOLECULE REACTIONS. I. THEORETICAL BASIS. Meisels, G. G.; Tibbals, H. F. (Univ. of Houston, Tex.). J. Phys. Chem., 72: 3746-53(Oct. 1968).

Relative ion abundances were calculated on the basis of a collision model for multiple order ion-molecule reactions. Allowance was made for the energy dependency of reaction cross sections and the existence of long-lived intermediates whose dissociation is assumed to follow unimolecular decay kinetics. Cross section and rate constant values severely affect calculated abundance curves and permit the assignment of reaction mechanisms. (auth)

47484 SYMPOSIUM ON PHOTOCHEMISTRY AND RADIATION CHEMISTRY, U. S. ARMY NATICK LABORATORIES, APRIL 22-24, 1968. Wall, Frederick T. (ed.). J. Phys. Chem., 72: 3709-935(Oct. 1968). (CONF-680464).

Thirty-seven papers presented at the conference are included. Separate abstracts were prepared for three papers. Fourteen papers were previously abstracted for NSA and appeared as

abstracts 23: 270, 271, 278, 279, 280, 281, 282, 285, 295, 299, 300, 301, 310, and 311. The remaining papers covered various aspects of photochemistry. (M.C.G.)

For abstracts of individual papers see: 47482, 47483, and 48707.

47485 ELECTRON PARAMAGNETIC RESONANCE OF CUPRIC ACETATE: IRRADIATION-INDUCED SPIN PAIRING. Morton-Blake, D. A. (National Physical Lab., Teddington, Eng.). J. Phys. Chem., 73: 2964-9(Sept. 1969).

X-irradiated crystals of cupric acetate monohydrate were investigated by EPR at 77 and at 4.2°K. At both temperatures prominent spectra of a $S = \frac{1}{2}$ species were obtained, indicating that the free spin produced by the irradiation in the ligand had paired with one of the spins in the Cu–Cu pair. Assuming cylindrical symmetry g and A components were evaluated by least-squares calculations on data taken from a single (arbitrary) crystal mounting position, giving $g_{||} = 2.458 \pm 0.002$, $g_{\perp} = 2.075 \pm 0.002$, $|A| = 435 \pm 10$ MHz, $|B| \simeq 70$ MHz. (auth)

47486 RADIATION-INITIATED CROSSLINKING OF CELLULOSE. Mares, Trinidad; Arthur, Jett C. Jr. (Dept. of Agriculture, New Orleans). J. Polym. Sci., Part B, 7: 419-25(June 1969).

Studies were made on the effects of ^{60}Co γ-radiosterilization on the absorption and retention of water in both vapor and liquid forms by cellulosic products. Purified cotton and wood celluloses were irradiated at 1.4 to 12×10^6 rad/hr. The liquid water retained by both irradiated celluloses decreased linearly with increasing dosage, but more liquid water was retained by the wood pulp than by the purified cotton cellulose. Also the rate of decrease in liquid water retained with increase in radiation dosage was greater for wood pulp than for purified cotton cellulose. The moisture regain was also greater for wood pulp than for purified cotton cellulose. The regains of both celluloses decreased to a minimum value with increasing radiation dosage. These results were interpreted as evidence for radioinduced formation of intermolecular crosslinks in cellulose. (G.M.C.)

47487 PREPARATION OF ^{236}Pu. Ishimori, Tomitaro; Akatsu, Eiko (Japan Atomic Energy Research Inst., Tokai). J. Nucl. Sci. Technol. (Tokyo), 6: 480-2(Aug. 1969).

Plutonium-236 was prepared by the reaction $^{237}Np(\gamma,n)^{236}Np \xrightarrow{\beta^-}$ for use as a radioactive tracer in environmental studies. The ^{237}Np target material was purified by anion exchange in a hydrochloric acid system and was then converted to the dioxide. The NpO_2 was bombarded with 20-MeV bremsstrahlung from a Pt converter of a linear electron accelerator for 8 hr at 20 μA and then 10 hr at 40 μA. The ^{236}Pu product was separated from the target material, daughter nuclide, and fission products by an anion exchange column. The gross α-activity of the total plutonium fractions was estimated to be 5×10^4 dpm, 20 m μCi. (G.M.C.)

47488 A STUDY OF THE AFTEREFFECT OF ^{57}Co ELECTRON CAPTURE IN $K_3[Fe(C_2O_4)_3] \cdot 3H_2O$ BY NUCLEAR γ-RESONANCE METHOD. Perfil'ev, Yu. D.; Kulikov, L. A.; Babeshkin, A. M.; Nesmeyanov, A. N. Vestn. Mosk. Univ., Ser. II. Khim., No. 4, 112-13(July–Aug. 1969). (In Russian).

Moessbauer spectra of ^{57}Fe produced by ^{57}Co electron capture in $K_3[Fe(C_2O_4)_3] \cdot 3H_2O$ were measured. The spectra showed the formation of Fe^{2+} with the expected state of Fe^{3+}. (auth)

47489 RADIOLYSIS OF CYCLOHEXANE AT VERY HIGH DOSE RATES. Boyd, A. W.; Willis, C.; Miller, O. A.; Rothwell, A. E. (Chalk River Nuclear Labs., Ont.). Advan. Chem. Ser., No. 82, 456-68(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.2).

Cyclohexane was irradiated at 0.2 to 25-Mrads at dose rates from 5×10^{24} to 8×10^{27} eV/gram sec. with 1.5 MeV electrons and with ^{60}Co γ-rays at 1×10^{16} eV/gram sec. Solutions of benzene, nitrous oxide, and sulfur hexafluoride in cyclohexane were irradiated at 6×10^{27} eV/gram sec. In pure cyclohexane from 5×10^{26} to 8×10^{27} eV/gram sec. $G(H_2) = 4.0 \pm 0.2$, $G(C_6H_{10}) = 2.6 \pm 0.3$, and $G(C_6H_{11})_2 = 1.1 \pm 0.2$ from 0.5 to 25 Mrads. At these dose rates $G(C_6H_{10})/G(C_6H_{11})_2$ is 2.6 ± 0.1, whereas it is 2.0 ± 0.1 at 10^{18} eV/gram sec. At 5×10^{24} to 5×10^{25} eV/gram sec. only product ratios were determined, but $G(C_6H_{10})/G(C_6H_{11})_2$ decreased significantly, suggesting that radical–radical reactions occur which are negligible at the low dose rates. Cyclohexene and bicyclohexyl product yields suggest that the additives used do not change the yield of thermal hydrogen atoms. (auth)

47490 RADIOLYSIS OF FLUOROCARBONS. VALENCE TAUTOMERIZATION. Fajer, J.; Mackenzie, D. R. (Brookhaven National Lab., Upton, N. Y.). Advan. Chem. Ser., No. 82, 469-74(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.2).

Fluorocarbon compounds were radiolyzed to establish the existence and assess the role of valence tautomers in radiation chemistry. Dewar-octafluorotoluene and -decafluoroxylene were isolated and identified as products of the photolysis and radiolysis of their respective aromatic parent in condensed phase. Dewar hexafluorobenzene was irradiated to 10 Mrad doses and found to revert to its Kekulé isomer with a G-value of ≈10, to polymerize with $G \approx 20$, and, in addition, to give rise to a new isomer. The concept of an "energy sink" is introduced whereby part of the energy absorbed by an aromatic system is stored in the form of interconvertible valence isomers which react further to yield polymers or decay to the ground state. (auth)

47491 A REVIEW OF RADIATION-CHEMICAL SYNTHETIC REACTIONS WITH ALKYL HALIDES. Vereshchinskii, I. V.; Lebedev, L. D.; Miretskii, V. Yu.; Podkhalyuzin, A. T. (Karpov Inst., Moscow). Advan. Chem. Ser., No. 82, 475-87(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.2).

The radiation–chemical synthesis of dibutyltin dibromide from n-butyl bromide and metallic tin is characterized by an induction period, a considerable radiation–chemical yield, a square-root dependence on the dose rate and is most likely a chain process. The radiation–chemical synthesis of decachloropentane from 1,1,1,5-tetrachloropentane and molecular chlorine is a multistage chain process. Optimum conditions prevail when chlorination is conducted at moderate temperatures and low dose rates. Cyanogen chloride, synthesized from tetrachloroethylene or carbon tetrachloride and free nitrogen, is a product of the radiation–chemical fixation of nitrogen. (auth)

47492 THE REACTION OF NITROUS OXIDE WITH EXCITED MOLECULES IN THE RADIOLYSIS AND PHOTOLYSIS OF LIQUID ALKANES. Holroyd, R. A. (North American Rockwell Corp., Canoga Park, Calif.). Advan. Chem. Ser., No. 82, 488-98(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.2).

In the 1470-A. photolysis of cyclohexane–nitrous oxide solutions, nitrous oxide reacts with excited cyclohexane molecules to form nitrogen and oxygen atoms. The reaction of N_2O with photoexcited 2,2,4-trimethylpentane molecules is much less efficient than with cyclohexane. In the radiolysis of these solutions, $G(N_2)$ is the same for different alkanes at low (≅5 mM) N_2O concentrations. At higher concentrations, $G(N_2)$ from the radiolysis of cyclohexane is greater than $G(N_2)$ from the radiolysis of 2,2,4-trimethylpentane solutions. The N_2 yields from 2,2,4-trimethylpentane are in excellent agreement with the theoretical yields of electrons expected to be scavenged by N_2O. The yield of N_2 in the radiolysis of cyclohexane that is in excess of that formed from electrons is attributed to energy transfer from excited cyclohexane molecules to nitrous oxide. (auth)

47493 PULSE RADIOLYSIS OF MONOMERS AND POLYMERS. Swallow, A. J. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Advan. Chem. Ser., No. 82, 499-512(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.2).

In aqueous solution the primary radiolysis products react rapidly at the vinyl group of monomers, giving ions or radicals. For styrene and α-methylstyrene, appreciable ring addition occurs also. Rate constants for reactions of the radicals formed are tabulated. Styrene and α-methylstyrene in the pure state give rise to short-lived anions and long-lived radicals on irradiation, and the results are correlated with those obtained from measurements on the polymer which is formed. Ionic reactions are important in the irradiation of styrene and α-methylstyrene in organic solvents. Studies are reported on the mechanism of protection of polymers by sulfur-containing compounds. When irradiated in the solid state, poly(methyl methacrylate) gives some radicals that disappear over tens or hundreds of microseconds, leaving behind further radicals which remain trapped. (auth)

47494 IONIC POLYMERIZATION IN IRRADIATED GLASSES. Chapiro, A.; Jendrychowska-Bonamour, A. M.; Perec, L. (CNRS, Bellevue, France). Advan. Chem. Ser., No. 82, 513-24(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.2).

Anionic polymerizations were observed on irradiating vitreous mixtures of acrylonitrile with N,N-dimethylformamide, triethylamine, and isopropylamine. The reaction rate was highest in mixtures that form an optically clear glass at low temperatures. Irradiation at different temperatures showed that the rate exhibited a sharp maximum a few degrees above the glass transition

point, T_g. Below this temperature no chain propagation occurred during irradiation, but an ionic postpolymerization was found after irradiation, while the mixture was warmed to room temperature. Cationic polymerizations were observed in vitreous solutions of styrene in hexachlorobutadiene and methylene chloride. Again the rate was highest near T_g. Poly(vinyl chloride) films were swollen at room temperature in mixtures of isobutylene and chloroform and irradiated at −78° and −196°C. A cationic graft copolymerization was observed under such conditions. (auth)

47495 THE ULTRAVIOLET AND INFRARED SPECTRA OF FREE RADICALS IN IRRADIATED POLYETHYLENE. Dole, Malcolm (Northwestern Univ., Evanston, Ill.); Boehm, G. G. A. Advan. Chem. Ser., No. 82, 525-36(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.2).

Transient as well as stable ultraviolet absorption bands were produced during the γ or electron beam irradiation of polyethylene. These bands have been observed subsequent to the irradiation at temperatures varying from 77°K to 120°C, and from the variation in their intensities conclusions concerning the mechanism of their formation and decay can be postulated. The assignment of the bands to specific ultraviolet absorbing groups was aided by theoretical predictions and by previous work on low molecular weight compounds studied either in the gas phase or in frozen matrices. Ultraviolet spectroscopy is a valuable complement to ESR techniques in studying transient free radicals in irradiated polyethylene. (auth)

47496 ELECTRON-SCAVENGING PROCESSES IN THE RADIOLYSIS OF HYDROCARBON SOLUTIONS. Warman, John M.; Asmus, K.-D.; Schuler, Robert H. (Carnegie-Mellon Univ., Pittsburgh). Advan. Chem. Ser., No. 82, 25-57(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.2).

The current state of knowledge of electron-scavenging processes in liquid hydrocarbons is summarized. Interpretation of data is critically discussed in the light of the possible complicating factors. The relation $G(S^-) = G_{fi} + \{G_{gi}[\alpha_s(S)]^{1/k}/1 + [\alpha_s(S)]^{1/k}\}$ is found to describe the concentration dependence of electron scavenging in a number of cases. Using this relation it is shown that a detailed treatment of the scavenging kinetics in competitive situations is possible. Secondary reactions involving negative ions are postulated to explain anomalies found in the available data. For nitrous oxide solutions the high nitrogen yields observed can be quantitatively explained by secondary ionic reactions with the nitrous oxide. (auth)

47497 PULSE RADIOLYSIS STUDIES OF SOME REACTIVE STATES OF AROMATIC MOLECULES IN SOLUTION. Dorfman, Leon M.; Shank, Norman E.; Arai, Shigeyoshi (Ohio State Univ., Columbus). Advan. Chem. Ser., No. 82, 58-71(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.2).

Reactive states of aromatic molecules in solution may be observed directly by the pulse radiolysis method. Extensive investigations of both aromatic molecule ions (particularly the radical anions) and electronically excited states have provided new information about not only the radiation chemical processes but also the general kinetic behavior of these reactive intermediates. Absolute rate constants were determined for many elementary processes such as energy transfer and electron and proton transfer reactions. (auth)

47498 STABILIZATION OF ELECTRONS IN LOW TEMPERATURE RADIOLYSIS OF POLAR SYSTEMS. Ershov, B. G.; Pikaev, A. K. (Inst. of Physical Chemistry, Moscow). Advan. Chem. Ser., No. 81, 1-23(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.1).

Results of a study on the nature and properties of trapped electrons (e_{tr}^-) in irradiated frozen aqueous and alcoholic systems are presented. These species are observed not only in alkaline ices and alcoholic glasses at 77°K, but also in glassy aqueous solutions of $NaClO_4$, LiCl, KF, K_2CO_3, alcohols, HCHO, HCOONa, carbohydrates, etc. In these systems e_{tr}^- has narrow symmetrical singlet at g-factor ~2001 in EPR spectrum and wide optical absorption band in visible region. The yields of e_{tr}^- were measured. In aqueous glasses the e_{tr}^- and $(e_{tr}^-)_2$ are mutually transformed under certain conditions. The data obtained by studying the photochemistry of e_{tr}^- indicate the existence of dispersion of trapping energy. The nature of electron stabilization is discussed. (auth)

47499 THEORY OF RADIATION CHEMISTRY. IX. MODEL AND STRUCTURE OF HEAVY PARTICLE TRACKS IN WATER. Mozumder, A.; Chatterjee, A.; Magee, J. L. (Univ. of Notre Dame, Ind.). Advan. Chem. Ser., No. 81, 27-48(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.1).

The structure of heavy particle tracks in water is described with special reference to the highly charged ions of carbon through neon. Range, effective charge, and contribution of charge changing processes to total energy loss were computed as a function of particle energy and quality using a Monte Carlo procedure. Bohr's formulas were used for electron capture and loss with slight modifications to adapt to the present case. A model of heavy particle tracks was proposed for use in radiation chemistry. This consists of a core of high ionization density surrounded by emergent secondary electrons of lower ionization density. Extension of the present model to protons, α-particles and fission fragments is briefly considered. (auth)

47500 HYDRATED ELECTRONS IN CHEMISTRY. Walker, David C. (Univ. of British Columbia, Vancouver). Advan. Chem. Ser., No. 81, 49-64(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.1).

Following the discovery of the hydrated electron in radiation chemistry, the reexamination of some fields of aqueous chemistry gave rise to a new concept of primary reduction processes. Aspects of these investigations were examined in which it appears that e_{aq}^-, as opposed to its conjugate acid (H atom), is invariably the precursor to H_2 when water is reduced. Evidence is reviewed for the production of e_{aq}^- (a) photochemically, (b) by chemical reduction of water, (c) electrolytically, (d) by photoinduced electron emission from metals, (e) from stable solvated electrons, and (f) from H atoms. The basis of standard electrode potentials and various aspects of hydrated electron chemistry is discussed briefly. (auth)

47501 FURTHER PREDICTIONS OF THERMODYNAMIC PROPERTIES OF THE HYDRATED ELECTRON. Noyes, Richard M. (Univ. of Oregon, Eugene). Advan. Chem. Ser., No. 81, 65-70(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.1).

The free energy, enthalpy, entropy, and volume of the hydrated electron are measurable in principle from the temperature and pressure dependencies of the forward and reverse rates of the unimolecular reaction of this species with water to form hydrogen atom and hydroxide ion. Data presently available determine values only for free energies of activation in both directions and for enthalpy and entropy of activation in one direction. Values for the other properties can be predicted if it is assumed that the enthalpy, entropy, and volume of the hydrated electron can be calculated by extrapolating measurements on halide ions to the radius (2.98 A.) necessary to fit the free energy data. The predictions for enthalpy and entropy are thought to be reasonably accurate, but the value for volume change is less reliable. (auth)

47502 PULSE RADIOLYSIS OF ICE AND FROZEN HF SOLUTIONS. Nilsson, G. (Aktiebolaget Atomenergi, Studsvik, Sweden); Christensen, H. C.; Fenger, J.; Pagsberg, P.; Nielsen, S. O. Advan. Chem. Ser., No. 81, 71-8(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.1).

A transient species, supposed to be a trapped electron, was observed in pure ice and in frozen 3×10^{-5} M HF solution by means of the pulse radiolysis technique. The maximum of the absorption band of the transient is located at about 680 nm in pure ice at −10°, −31°, and −50°C. The half-width of the band is considerably smaller than that of the solvated electron in liquid water. The G-values for the transient are estimated to be 0.3, 0.07, and 0.02 at −10°, −31°, and −50°C respectively and to be 0.1 in the frozen HF solution at −10°C. The decay of the transient is complex in pure ice but first order in the frozen HF solution. (auth)

47503 REACTIVITY OF HYDRATED ELECTRONS TOWARD INORGANIC COMPOUNDS. Anbar, Michael; Hart, Edwin J. (Argonne National Lab., Ill.). Advan. Chem. Ser., No. 81, 79-94 (1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.1).

The rates of reaction of a number of inorganic complex ions and oxy-anions with hydrated electrons were measured and the parameters that determine the rate of their diffusion-controlled reactions were evaluated and discussed. Ligands modify the reactivity of ions by their effect on the configuration and stability

of the lower state of oxidation, on the electronic distribution of the central atom, and on their capacity of acting as electron transfer bridges. Each of these factors contributes to the reactivity of inorganic complexes. The reaction cross section of certain highly reactive oxidants is significantly larger than their crystallographic dimensions, suggesting long range electron tunneling. General trends in the reactivity of the hydrated electron with inorganic compounds are discussed. (auth)

47504 CONCENTRATION INFLUENCE OF DIFFERENT ACCEPTORS IN PULSE RADIOLYSIS OF AQUEOUS AND AMMONIUM SOLUTIONS. Shubin, V. N.; Zhigunov, V. A.; Khaikin, G. I.; Beruchashvili, L. P.; Dolin, P. I. (Inst. of Electrochemistry, Moscow). Advan. Chem. Ser., No. 81, 95-105(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.1).

Pulse radiolysis of some scavenger solutions in water, intermediates spectra, and kinetics of their decay in liquid ammonia are investigated. Rate constant and activation energy are calculated for the latter. The dependence of the disappearance of intermediates on concentration is analyzed. It is shown that rate constant of reactions of pseudo-first order is not proportional to acceptors concentration. One of the possible reasons is that first order reaction was not taken into consideration. On this basis, rate constants of reactions with acceptors and these of monomolecular decay are calculated. It is revealed the decay of intermediates in 10^{-5} to 10^{-3} M perchloric acid solutions does not depend upon H_3O^+ ion concentration. This fact is contrary to the present day theories about the nature of intermediates. (auth)

47505 RADICAL YIELDS AS A FUNCTION OF pH AND SCAVENGER CONCENTRATION. Czapski, Gideon (Hebrew Univ., Jerusalem). Advan. Chem. Ser., No. 81, 106-30(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.1).

G-values of radicals and molecular products have been measured and have appeared in numerous publications. It has been generally assumed that at extreme acidity, alkalinity, or at high concentrations of radical scavengers, the radical yields effectively increase. This behavior was summarized in a recent review by Hayon, who generalized by assuming G radicals to depend solely on the product of $k_{R+S} \cdot [S]$. This approach is criticized on theoretical (the different models proposed) as well as experimental grounds. In many cases, where G values of radicals seem to depend on pH or scavenger concentrations, the effect observed was really an artifact caused by neglecting the effect of back reactions. (auth)

47506 PULSE RADIOLYSIS OF ALKALINE SOLUTIONS. Rabani, Joseph (Hebrew Univ., Jerusalem). Advan. Chem. Ser., No. 81, 131-52(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.1).

The absorption spectrum of O^-, with a peak at 2400 A. (ϵ = 240 M^{-1} cm^{-1}) is reported. Extinction coefficients at 2600 A of intermediates produced in alkaline solutions are reported. $\epsilon_{O^-}^{2600} = 200$, $\epsilon_{O_2^-}^{2600} = 1000$ at neutral pH, 1100 in alkaline solutions containing both N_2O and H_2O_2, and 1900 and 1600 in aerated and oxygenated solutions respectively (all at pH = 13, in units of M^{-1} cm^{-1}). The possible formation of species equivalent to O_2^- and having different absorptions is discussed. The effect of pH on the apparent reaction rate constant of hydroxyl radicals with hydrogen peroxide was studied. Results are: $k_{(O^- + HO_2^-)} = 2.74 \times 10^9$ M^{-1} sec^{-1} for zero ionic strength, and $(k_{(O^- + H_2O_2)} + 1.42\ k_{(OH + HO_2^-)}) = 1.18 \times 10^{10}$ M^{-1} sec^{-1}. The error in the rate constants and extinction coefficients is 10 to 15%. (auth)

47507 RADIOLYSIS AND PHOTOLYSIS OF THE AQUEOUS NITRATE SYSTEM. Daniels, Malcolm (Oregon State Univ., Corvallis). Advan. Chem. Ser., No. 81, 153-63(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.1).

Radiolysis of the aqueous nitrate system is discussed in terms of (a) indirect effect in dilute solution, and (b) concurrent indirect and direct effects in concentrated solution. Analysis of energy fractionation breaks down (b), gives $G(NO_2^-)/NO_3^- = 4.0$, and demonstrates stoichiometry for direct effect according to $2\ NO_3^- \rightarrow 2\ NO_2^- + O_2$. Scavenging with H_2 and n-propyl alcohol quantitatively supports this. Pulse radiolysis shows NO_3 and NO_2 as intermediates, NO_3 being characteristic of concentrated solutions. Formation and decay of NO_3 is discussed. Primary process of direct radiolysis is formulated as $NO_3^- \longrightarrow (NO_2 + O + e^-)$ cage, spur $G(NO_2^-)/NO_3^-$ varies with scavenger and may attain ~17. From photochemical studies participation of lowest excited state is unlikely, but the second state at 6 eV may be involved. (auth)

47508 RADIATION CHEMISTRY OF CONCENTRATED $NaNO_3$ SOLUTIONS: DEPENDENCE OF $G(HNO_2)$ ON $NaNO_3$ CONCENTRATION. Sworski, T. J.; Matthews, R. W.; Mahlman, H. A. (Oak Ridge National Lab., Tenn.). Advan. Chem. Ser., No. 81, 164-81(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.1).

Post-irradiation reduction of cerium(IV) occurs when concentrated sodium nitrate solutions in air-saturated 0.4 M sulfuric acid containing 10^{-4} M cerium(IV) are irradiated with a kilocurie ^{60}Co source. A kinetic study of the reaction of cerium(IV) with nitrous acid established that the post-irradiation reaction is reduction of cerium(IV) by nitrous acid. A computer program SLOPULSE was used to determine $G(HNO_2)$ by kinetic analyses of both the post-irradiation reduction of cerium(IV) and reduction of cerium(IV) by nitrous acid during irradiation. The importance of nitrous acid as an intermediate is evidenced by the high values for $G(HNO_2)$. For example, about 70% of the reduction of cerium(IV) in 5.0 M sodium nitrate solutions is caused by nitrous acid with $G(Ce^{III}) = 6.04$ and $G(HNO_2) = 2.22$. (auth)

47509 RADIATION CHEMISTRY OF PERSULFATES. Mariano, Maria Helena B. (Laboratorio de Fisica e Engenharia Nucleares, Sacavem, Portugal). Advan. Chem. Ser., No. 81, 182-92(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.1).

The effects of peroxydisulfate concentration, of pH, of time of irradiation, and of added radical scavengers on the rate of decomposition of peroxydisulfuric acid, in the ^{60}Co γ-radiolysis of this compound are reported. In dilute H_2SO_4 solutions, the rate of $S_2O_8^{2-}$ decomposition is very small. $G(-S_2O_8^{2-})$ decreases with pH and, at constant acidity, increases with $[K_2S_2O_8]$. It is inferred that SO_4^- radicals compete with peroxydisulfate for reaction with HO_2. The reactions $SO_4^- + OH \rightarrow HSO_5^-$ and $SO_4^- + SO_4^- \rightarrow S_2O_8^{2-}$ do not take place in the bulk of the solutions. The probability of the dimerization of the sulfate radical within the spurs is small as compared with the probability of occurrence of the other SO_4^- reactions. Peroxydisulfuric acid is protected against radical attack by added Br^- ions or peroxymonosulfate. (auth)

47510 A PULSE RADIOLYSIS STUDY OF BIVALENT AND ZEROVALENT GOLD IN AQUEOUS SOLUTIONS. Ghosh-Mazumdar, A. S. (Bhabha Atomic Research Centre, Trombay, India); Hart, Edwin J. Advan. Chem. Ser., No. 81, 193-209(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.1).

Transient bivalent gold ions and two unidentified species, possibly Au^0, were prepared and studied in different aqueous matrices by pulse radiolysis. Their absorption spectra and rate constants of formation and decay are reported. Bivalent gold was prepared by the oxidation of $Au(CN)_2^-$ in neutral chloride solutions of N_2O, and also by the reduction of $AuCl_4^-$ in the presence of CH_3OH. The kinetics of its decay indicates disproportionation. The reduced species of $Au(CN)_2^-$ from H atoms is different from that obtained with e_{aq}^-, the latter being attributed to an electron adduct. Both of these species decay, forming colloidal gold. (auth)

47511 RADIOLYTIC TRANSIENTS FROM p-NITROPHENOL AND THEIR INTER- AND INTRAMOLECULAR REACTIONS. Cercek, B.; Ebert, M. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Advan. Chem. Ser., No. 81, 210-21(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.1).

The reactions of hydrated electrons, H and OH radicals with p-nitrophenol were studied using the technique of pulse radiolysis. The H and OH radicals react with the nitro-group to produce in acid solutions the radicals $HOC_6H_4NO_2H \cdot$ and $HOC_6H_4BO_3H \cdot$ or in neutral solutions the anion radicals $HOC_6H_4NO_2^- \cdot$ and $HOC_6H_4NO_3^- \cdot$, respectively. The optical absorption spectra and molar extinction coefficients of these species as well as their rates of formation and decay were obtained and the pK values for the protonation of the anion radicals estimated. An intramolecular rearrangement of the anion radical $HOC_6H_4NO_2^- \cdot$ was observed. (auth)

47512 PULSE RADIOLYSIS STUDIES. XIII. RATE CONSTANTS FOR THE REACTION OF HYDROXYL RADICALS WITH AROMATIC COMPOUNDS IN AQUEOUS SOLUTIONS. Neta, P.; Dorfman, Leon M. (Ohio State Univ., Columbus). Advan. Chem. Ser., No. 81, 222-30(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.1).

Absolute rate constants were determined for the reaction of the hydroxyl radical with a variety of aromatic compounds in

aqueous solution. The rate constants obtained are significantly higher than values previously reported. Rate constants for the reaction of the hydroxyl radical with methyl alcohol and ethyl alcohol were also determined by competition kinetics using three of these absolute rate constants as reference values. Comparison of results with the published values from competition kinetics suggests that the rate constants for the reaction of hydroxyl radicals with iodide ion and thiocyanate ion are significantly higher than reported in earlier work. The ultraviolet absorption bands of the various substituted hydroxycyclohexadienyl radicals formed were observed. (auth)

47513 PULSE RADIOLYSIS STUDIES OF DEAERATED AQUEOUS SALICYLATE SOLUTIONS. Amphlett, C. B. (Atomic Energy Research Establishment, Harwell, Eng.); Adams, G. E.; Michael, B. D. Advan. Chem. Ser., No. 81, 231-50(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.1).

Salicylate ion forms transient adducts with H atoms, OH radicals, and e^-_{aq} when deaerated solutions are irradiated with a pulse of 1.8 MeV electrons. The absorption band due to the electron adduct is centered on 4400 A., while the H and OH adducts absorb between 3500 and 4000 A. The rates of formation of the adducts, determined directly and by competitive methods, are k(H + salicylate) = 1.4×10^9, k(OH + salicylate) = 1.2×10^{10} and k(e^-_{aq} + salicylate) ~ 10^{10} liter mole^{-1} sec.$^{-1}$. The electron adduct is rapidly protonated. All three adducts disappear principally by second-order reactions with half-lives that decrease markedly in acid solution compared with their values in neutral solution. (auth)

47514 THE SENSITIZING EFFECT OF N_2O ON X-RAY INDUCED DEGRADATION OF BENZOIC ACID AND ANTHRANILIC ACID. Nakken, K. F.; Brustad, T.; Hansen, A. Karthum (Norwegian Radium Hospital, Montebello, Norway). Advan. Chem. Ser., No. 81, 251-66(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.1).

To shed light on the proposed reaction: $N_2O + e^-_{aq} \rightarrow N_2O^- \xrightarrow{H^+} N_2 + OH$ effects of the electron scavengers O_2, N_2O, NO_3^-, and H_2O_2 on x-ray induced degradation of anthranilic acid (AA) and benzoic acid (B) were studied. AA($2 \times 10^{-5} - 3 \times 10^{-4}$M) was degraded with G-values of 0.25 in N_2, 1.2 in O_2, 1.2 to 1.6 in N_2O, and 2.2 with nitrate (1×10^{-2}M) in N_2. For B(6×10^{-4}M) the G-values of hydroxybenzoic acids were 0.20 in N2, 1.19 in O_2, 0.45 in N_2O, and 0.88 with H_2O_2 (4.4×10^{-3}M) in N_2. Thus, O_2 is able to oxidize B radicals. All electron scavengers studied suppress e^-_{aq} induced back reactions, but only H_2O_2 converts e^-_{aq} into OH. N_2O converts e^-_{aq} into a radical less reactive than NO_3^- and OH. (auth)

47515 COMPACT APPARATUS FOR PHOTOGENERATION OF HYDRATED ELECTRONS. Schmidt, Klaus; Hart, Edwin J. (Argonne National Lab., Ill.). Advan. Chem. Ser., No. 81, 267-79(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.1).

A new flash photolysis instrument, especially designed to generate hydrated electrons and study their reactions, is described in detail. With a new three-dimensional multiple reflection cell and its capacity to produce up to 10^{-7}M e^-_{aq} in a single 40-μsec. light pulse, this instrument provides adequate sensitivity for determining e^-_{aq} rate constants and for use in analytical chemistry. With this instrument less than 10^{-9}M e^-_{aq} may be detected. (auth)

47516 MOLECULAR AND RADICAL PRODUCT YIELDS IN ALPHA-RADIOLYSIS OF 0.8N H_2SO_4. Vladimirova, M. V. (State Committee of Utilization of Atomic Energy, Moscow). Advan. Chem. Ser., No. 81, 280-5(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.1).

The newest and most reliable results of investigations of α-radiolysis of 0.8N H_2SO_4, $FeSO_4$, and $Ce(SO_4)_2$ solutions are discussed. Based on the results discussed the yields of radical products of radiolysis were calculated, and the yield of water decomposition was found to be 3.35 molecule/100 eV in aerated solution. This G(−H_2O) value is lower than those determined before (3.5 to 3.7). Values of the yields of intratrajectory reactions (H_2O_2 + OH, H_2 + OH, H_2O_2 + H) calculated from the experimental data as well as the yield of track reaction (H + OH) calculated from the above relationship between the yields of radiolysis products and the LET value are given. The initial yields of water decomposition in α-radiolysis are calculated; the yields of intratrajectory reactions (G_{-H_2O} = 4.35 molecule/100 eV) and the yield of H + OH reaction (G_{-H_2O} = 7.0 molecule/100 eV) are taken into account. (auth)

47517 ELECTRON TRANSFER STUDIES BY PULSE RADIOLYSIS. Adams, G. E.; Michael, B. D.; Willson, R. L. (Mount Vernon Hospital, Northwood, Eng.). Advan. Chem. Ser., No. 81, 289-308(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.1).

A general review of pulse radiolysis studies on electron transfer in solution is presented together with some recent unpublished data. Electron transfer processes occurring in irradiated solutions of metal ions, inorganic anions, and various aliphatic and aromatic organic compounds are discussed with respect to general redox phenomena in radiation and free radical chemistry. Specific topics include the measurement of peroxy radical formation, the use of nitrous oxide in alkaline radiation chemistry, and cascade electron transfer processes. Some implications of the kinetics of electron transfer are discussed briefly. (auth)

47518 RADIATION CHEMISTRY. VOLUME II. GASES, SOLIDS, ORGANIC LIQUIDS. An International Conference, Argonne National Laboratory, Argonne, Ill., Aug. 12–15, 1968. Gould, Robert F. (ed.). Advances in Chemistry Series 82. Washington, D. C., American Chemical Society, 1968. 574p. (CONF-680806-(Vol.2)).

An abstract was prepared for each of the thirty-six papers in this volume. Abstracts of seventeen oral presentations are also included in the volume. (D.H.M.)

For abstracts of individual papers see: 47489–47497, 47534–47558, 48741, and 48979.

47519 THE APPLICATION OF PULSE RADIOLYSIS TO THE RADIATION CHEMISTRY OF ORGANIC DYES. Grossweiner, Leonard I. (Illinois Inst. of Tech., Chicago. Michael Reese Hospital and Medical Center, Chicago). Advan. Chem. Ser., No. 81, 309-20(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.1).

Pulse radiolysis studies have shown that many organic dyes are highly reactive toward the products of water radiolysis. Dyes with quinonoid structures are reduced by e^-_{aq} to the semiquinone in encounter-limited reactions. Hydroxyl radicals react by oxidation and addition processes. In general, reductive bleaching takes place via semiquinone dismutation, while oxidative decoloration is a complex process involving several OH radicals. The complexing of dyes to high molecular weight substrates leads to a marked change of e^-_{aq} reactivity. Some oxidized dye intermediates and triplet states react with e^-_{aq} in chemiluminescent processes. (auth)

47520 LUMINESCENCE KINETICS OF MICROCRYSTALLINE ADENINE FOLLOWING PULSE IRRADIATION. Fielden, E. M.; Lillicrap, S. C. (Inst. of Cancer Research, Sutton, Eng.). Advan. Chem. Ser., No. 81, 444-63(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.1).

The spectra decay kinetics of the luminescence of microcrystalline adenine following irradiation by 4.3 MeV electrons are reported over a temperature range from 93° to 540°K. At the lowest temperatures the emission is followed from 5 μsec. to 5 min after a 1.6 μsec electron pulse, and over this time scale the emission intensity decreases by a factor of 10^7. A first order phosphorescence decay component is observed below 130°K between 5 msec and 8 sec. The residual non-exponential decay components can be explained by a trapping model possessing a uniform distribution of traps from 0 to 0.22 eV deep with frequency factors ~10^9 sec^{-1}. An alternative explanation of the initial decay in terms of a cluster ("spur" type) model that is consistent with the data is also discussed. (auth)

47521 THE INFLUENCE OF CHANGES IN CONFORMATION OF A MACROMOLECULE ON REACTION RATES. Braams, Reinier (Utrecht Univ.); Ebert, Michael. Advan. Chem. Ser., No. 81, 464-71(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.1).

The change in the rate constants with temperature for the reactions of ribonuclease (RNase) with hydrated electrons and OH radicals was measured. The RNase molecule unfolds reversibly at elevated temperatures exposing sites particularly reactive towards hydrated electrons. The theoretical treatment leads to an estimate of the encounter frequencies for differently shaped macromolecules with small radiolytically produced solvent radicals. The derived encounter frequencies are compared with experimentally determined rate constants. Values as high as 10^{13} M^{-1} sec^{-1} are understandable. (auth)

47522 EFFECT OF γ-IRRADIATION ON AQUEOUS SOLUTIONS OF THE CYCLIC DODECAPEPTIDE POLYMYXIN B.

Kopoldova, J. (Insts. for Biological Research, Prague). Advan. Chem. Ser., No. 81, 472-9(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol. 1).

The radiation behavior of cyclic, antibiotically active dodecapeptide polymyxin B was studied by irradiating its 0.5% aqueous solutions in oxygenated and oxygen-free atmospheres at doses of 1.36×10^5 to 131.7×10^5 rad. The radiation products were determined in the irradiated solutions and in their hydrolysates, as well as the decrease of the content and biological activity of polymyxin. Both of these amounted to 45% at a dose of 13.7×10^5 rad. It was found that the main radiation mechanisms in solutions of polymyxin correspond, in general, to those described for the radiolysis of simple peptides. The major reactions in oxygenated solutions are oxidative deamination, Garrison's cleavage of peptide bonds, and oxidative reactions in the amino acid residues. In oxygen-free media, reductive deamination and recombination reactions are the main processes. (auth)

47523 RADIATION CHEMICAL STUDIES ON OXYGEN-CARRYING PROTEINS: HEMOCYANIN. Schubert, Jack; White, E. R.; Becker, L. F. Jr. (Univ. of Pittsburgh). Advan. Chem. Ser., No. 81, 480-95(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.1).

The oxygen-carrying capacity of the nonheme copper protein, hemocyanin, is reduced by irradiation of the oxygenated protein with gamma and x rays with $G(-O_2) = 0.9 - 1.2$. Measurements are made on hemocyanin in its own serum at relatively low doses (0 to 80 krads). Oxygenated hemocyanin is resistant to irradiation but loses its oxygen-carrying capacity only when deoxygenated following irradiation in the oxygenated state. Irradiation of the deoxygenated form is without effect on the oxygen-carrying capacity. The effect of irradiation on hemocyanin involves the oxidation of protein-bound copper atoms to the Cu(II) state by radiolytic hydrogen peroxide in the same manner as is produced by adding H_2O_2 to unirradiated hemocyanins. The effects of organic peroxides, pH, urea, catalase, and other factors on the oxygenation of hemocyanin are described. (auth)

47524 TRITIATED FREE RADICAL SCAVENGERS IN THE STUDY OF THE IRRADIATED PROTEIN MOLECULE. Riesz, P.; White, F. H. Jr. (National Insts. of Health, Bethesda, Md.). Advan. Chem. Ser., No. 81, 496-520(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.1).

The use of gaseous tritiated radical scavengers to determine the secondary free radical distribution in γ-irradiated lyophilized macromolecules was explored. For proteins the similarity of the tritium distributions obtained with tritiated H_2S and HI as well as studies with $H_2{}^{35}S$, support the assumption that these distributions are an approximate measure of the secondary radical distribution. Radical distributions of several native proteins were characteristically different, those of denatured proteins approximately the same, thus demonstrating a pronounced effect of conformation. In contrast to proteins, the reaction of irradiated dry DNA with tritiated H_2S or HI gave approximately 100 times more tritium label on the DNA than expected from the initial concentration of free radicals in the DNA. (auth)

47525 THE OPTICAL APPROXIMATION, PRIMARY RADIATION CHEMICAL YIELDS, AND STRUCTURE OF THE TRACK OF AN IONIZING PARTICLE. Santar, Ivan; Bednar, Jaroslav (Inst. for Nuclear Research, Rez, Czech.). Advan. Chem. Ser., No. 81, 523-38(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.1).

A survey is given of the theory of the physical stage of radiolysis. Using the optical approximation to cross sections for the interaction between fast electrons and molecules, expressions were derived for the yield g^o of primary optical activations, and for the total absorbed energy Q_{tot}. It is shown that the total yield g of primary activations is conveniently discussed as a sum $g^o + g^s$, where the first term includes the action of fast electrons, while g^s describes the action of slow electrons (kinetic energy less than about 100 eV) on molecules of the medium. This approach is compared with Platzman's considerations on primary yields and the differences are pointed out. Theoretical results are applied to the analysis of the initial structure of the track of a fast electron, consisting of spurs, blobs, and short tracks. (auth)

47526 ^{60}Co-γ-RAY INDUCED FORMATION OF SULFUR-CONTAINING AMINO ACIDS IN AQUEOUS SOLUTIONS. Getoff, N.; Schenck, G. O. (Max-Planck-Institut fuer Kohlenforschung, Muelheim, Ger.). Advan. Chem. Ser., No. 81, 337-44(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.1).

Experimental results on the radioinduced formation of sulfur-containing amino acids in aqueous solutions are reported. By carboxylation of 0.01M ethylamine with simultaneous incorporation of sulfur the following substances are identified: cystine, cysteine, cysteic acid, α- and β-alanine, and glycine. Cystine, alanine, and glycine are the main products. Different initial G values are obtained when either sodium sulfide, neutron irradiated sodium sulfide or hydrogen sulfide are used. In the first case G_i(cystine) = 0.2 and G_i(glycine + alanine) = 1.05; in the second case, G_i(cystine) = 0.5 and G_i(cystine + alanine) = 0.3 and in the third case, G_i(cystine) = 1.65 and G_i(glycine + alanine) = 0.14. In order to explain the results a probable reaction mechanism is suggested. (auth)

47527 PULSE RADIOLYSIS OF DNA AND RELATED PYRIMIDINE COMPOUNDS: REACTIONS OF THE OH· FREE RADICAL. Myers, L. S. Jr.; Hollis, Mary Lynn; Theard, L. M. (Univ. of California, Los Angeles. Gulf General Atomic, Inc., San Diego, Calif.). Advan. Chem. Ser., No. 81, 345-67(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.1).

Formation, decay, and absorption spectra of transient species produced by reaction of OH· free radicals with DNA and nucleic acid constituents were investigated by pulse radiolysis. Dilute aqueous N_2O saturated solutions were exposed to 2 to 500 nsec pulses (750 to 1700 rads/pulse) of 10 MeV electrons, and changes in optical density were measured. The rate constant for formation of the DNA transient (nucleotide M.W. 350) is 6×10^8 M^{-1} sec^{-1}. The transient persists for more than 1 msec with no significant change in spectrum. Thymine, uracil, deoxyribose, and thymidine transients have complex decay patterns that vary with pH. Comparisons of transient spectra confirm that the sites of attack by OH· on thymine, 5-methylcytosine, and thymidine depend on pH. Abstraction from 5,6-dihydrothymine is slower than addition to thymine. (auth)

47528 STEADY STATE AND PULSE RADIOLYSIS OF AQUEOUS CHLORIDE SOLUTIONS OF NUCLEIC ACID COMPONENTS. Ward, J. F.; Kuo, I. (Univ. of California, Los Angeles). Advan. Chem. Ser., No. 81, 368-73(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.1).

The pulse radiolysis technique was used to measure absolute rate constants for reactions of some nucleic acid constituents with Cl_2^- radicals (the species produced by reaction of OH radicals with chloride ions in acid aqueous solution). The rate of disappearance of the Cl_2^- absorption spectrum was measured in the absence and presence of the various solutes. Rate constants for the corresponding OH radical reactions are found to be 20 to 200 times greater than the rate constants for the Cl_2^- radical reactions. Steady state radiolysis showed that in some cases the radicals produced by reaction of these compounds with Cl_2^- radicals differ in their subsequent reaction from the corresponding OH radical adduct. (auth)

47529 THE RADIATION CHEMISTRY OF ANHYDROUS SOLID STATE GLYCINE, ALANINE, AND GLYCINE SALTS. Gottschall, W. Carl Jr.; Tolbert, Bert M. (Univ. of Colorado, Boulder). Advan. Chem. Ser., No. 81, 374-83(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.1).

The radiation chemistry of glycine and alanine as well as the alkali metal salts of glycine was investigated in the anhydrous solid state. Results of ^{137}Cs gamma irradiation indicate CO_2 is the chief gaseous product with larger amounts of NH_3 being released upon dissolution of the samples. Similarity of yields indicates little difference in decomposition mechanism and good agreement with the general mechanism postulated by Tolbert. $G(CO_2)$ values were glycine, 1.02; alanine, 0.89; sodium glycinate, 0.43; potassium glycinate, 0.54; rubidium glycinate, 0.91. Other products and their G values were for glycine $G(H_2) = 0.1$; $G(NH_3) = 4.3$, $G(CH_3NH_2) = 1$; G(-M) = 6 and for alanine $G(H_2) = 0.5$; $G(NH_3) = 3.3$; $G(CH_3CH_2NH_2) = 2$; G(-M) = 5. (auth)

47530 IONIZATION AND EXCITATION IN PEPTIDE RADIOLYSIS. Garrison, Warren M.; Jayko, Michael E.; Rodgers, Michael A. J.; Sokol, Harvey A.; Bennett-Corniea, Winifred (Univ. of California, Berkeley). Advan. Chem. Ser., No. 81, 384-96(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.1).

Major chemical effects of γ rays on simple peptides in the polycrystalline state, in the glassy state, and in concentrated aqueous solutions lead to degradation of the peptide chain. Several different

reaction modes are involved and these all yield amide-like products that readily hydrolyze to give ammonia. Major concomitant products include fatty acid, ketoacid, and aldehyde. Studies of N-acetylalanine glass containing added electron scavengers provide a measurement of the ionization yield, $G_{e^-} \simeq 3$. Conventional radical scavengers have relatively little effect on $G(NH_3) \simeq 3.5$. However, certain aromatic compounds effectively quench a major fraction of the (amide) ammonia yield. The evidence is that keto acid and aldehyde are formed from positive-ion intermediates while fatty acid and amide are derived through reactions involving excited (triplet) states. (auth)

47531 PULSE RADIOLYSIS STUDIES OF REACTIONS OF PRIMARY SPECIES IN WATER WITH NUCLEIC ACID DERIVATIVES. Greenstock, C. L.; Ng, M.; Hunt, J. W. (Univ. of Toronto). Advan. Chem. Ser., No. 81, 397-417(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.1).

Bimolecular rate constants were measured for the reactions of the solvated electron (e^-_{aq}) and the hydroxyl free radical (·OH) with a variety of nucleic acid derivatives. In neutral solution, the e^-_{aq} reaction rates are diffusion controlled and the ·OH reaction rates are only slightly lower. For uracil, the e^-_{aq} reactivity is reduced as the pH is increased partly because of the electrostatic repulsion from the negatively charged molecule and partly because of a tautomeric structural change. The ·OH reactivity shows no distinct changes around the pK_α value. The sites of attack of e^-_{aq} are probably the carbonyl groups in pyrimidines and the imidazole ring in purines. The primary site of attack of ·OH is the 5,6 double bond in pyrimidines. The reactivity per nucleotide is considerably reduced in long-chain polynucleotides, the effect increasing with chain length. (auth)

47532 PHOTOCHEMICAL GENETICS. I. THE IONIC NATURE OF URACIL PHOTOHYDRATION. Burr, J. G.; Gordon, B. R.; Park, E. H. (North American Rockwell Corp., Thousand Oaks, Calif.). Advan. Chem. Ser., No. 81, 418-34(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.1).

The rates of photohydration at 265 n.m. of uracil, 1-ethyluracil (EU), 1-cyclohexyluracil (CU), and 1-ribosyluracil (uridine) in oxygen-saturated water are found to be sigmoid functions of the pH over a pH range of 1.5 to 10. The rates of uracil photohydration (10^{-4}M solutions) are independent of the concentration of UH^+ and are unaffected by added NaCl. A mechanism is postulated which includes an equilibrium between singlet excited uracil molecules and hydrogen ions. The main product forming reaction in the pH range 1.5 to 7 is that between an excited $(UH^+)^*$ and a water molecule. At higher pH values, the reactive species seem to be excited uracil and a water molecule. It is inferred from these data that the pK^* of the four excited (UH^+)-type species are approximately 3.5 for $(UH^+)^*$, 6.5 for $(EUH^+)^*$, and 7.5 for $(CUH^+)^*$. (auth)

47533 STUDIES IN THE RADIATION AND PHOTOCHEMISTRY OF AQUEOUS p-NITROSODIMETHYLANILINE. Shah, Shirish; Trumbore, Conrad N.; Giessner, Bernard; Park, Woo (Univ. of Delaware, Newark). Advan. Chem. Ser., No. 81, 321-36(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.1).

Yields for the radiolytic bleaching of aqueous solutions of p-nitrosodimethylaniline (RNO) were found to be sensitive functions of oxygen and RNO concentrations, pH, and added OH radical scavenger concentration. The bleaching yields were independent of temperature and radiation intensity over a limited region of the above variables. The nature of a "residual" bleaching yield in excess ethyl alcohol and an unusual kinetic dependence on oxygen in acidic RNO solutions were investigated and the evidence, while strongly in favor of an OH radical attack on RNO, does not preclude an acidic form of the OH radical. Preliminary reports of H_2O_2–RNO photolysis of H_2O_2–Fe^{2+} flow system electron spin resonance studies are also reported. (auth)

47534 PRIMARY PROCESSES IN THE RADIOLYSIS OF GASEOUS AMMONIA. Johnson, G. R. A.; Simic, M. (Univ. of Newcastle upon Tyne, Eng.). Advan. Chem. Ser., No. 82, 197-211(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.2).

The H atom and molecular H_2 yields from irradiated NH_3 gas, measured by organic scavengers are $G_H = 7.2 \pm 0.5$ and $G_{H_2} = 0.8 \pm 0.2$. The depression of the H_2 yield from the system NH_3 + C_3H_8 (1.5 mole %) by the electron scavenger SF_6, $\Delta G(H_2) = 3.9 \pm 0.6$, corresponds closely to $G_{NH_4^+} = 3.8$, calculated from $W(NH_3)$. The total $G(H_2)$ and $\Delta G(H_2)$ in this system are temperature independent (20° to 200°C). The N_2 yield from NH_3 + C_3H_8 (>3%) + N_2O (1.5%), $G(N_2) = 3.8 \pm 0.2$, is equal to G_{e^-}, suggesting that in this system N_2 is formed only as a result of electron capture by N_2O. The formation of HD from $NH_3 + D_2$ occurs by a chain reaction both at 20° and 120°C. G(HD) depends on temperature and on D_2 concentration. (auth)

47535 ESR STUDY OF FREE RADICALS PRODUCED IN THE GAS PHASE BY LOW ENERGY ELECTRONS. ENERGY EFFECT ON THE PRODUCTION OF NH_2 IN NH_3. Marx, R.; Mauclaire, G. (Faculte des Sciences, Orsay, France). Advan. Chem. Ser., No. 82, 212-21(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.2).

An apparatus allowing the ESR study of free radicals produced by electron bombardment of gases is described. The energy of the electrons can be varied from 5 to a few hundred eV. The free radicals are trapped on a cold finger. For ammonia, between 8 and 30 eV, there are at least three different processes responsible for producing $^*NH_2$ radicals. Two of them, which have nearly the same threshold energies as NH_3^+ and NH_2^+ ions (10.4 and 15.7 eV) are ion–molecule reactions. The third, appearing near 18 eV is thought to be caused by the decomposition of a highly excited state of NH_3 molecules. The production of $^*NH_2$ below the first ionization potential of NH_3 cannot be excluded. (auth)

47536 THE STUDY OF ELECTRON DECAY IN PULSE-IRRADIATED GASES BY A MICROWAVE TECHNIQUE. Fessenden, Richard W.; Warman, John M. (Carnegie-Mellon Univ., Pittsburgh). Advan. Chem. Ser., No. 82, 222-30(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.2).

A microwave technique for measuring the decay of electrons in pulse irradiated gases is described. The technique involves the measurement of the change in resonant frequency of a microwave cavity caused by a change in the complex conductivity within the cavity when electrons are present. Single pulses of 3-MeV electrons from a Van de Graaff accelerator are used to ionize the gas. Electron densities as low as 10^7 cm^{-3} (total dose ~0.3 rad at 10 torr) can be measured accurately. In the absence of diffusion the method can be used to study electron loss by electron capture or electron–ion recombination for pressures as low as 1 torr and as high as at least 200 torr. The potential of the technique is illustrated by results obtained with pulse-irradiated air. (auth)

47537 EFFECT OF OXYGEN ON THE RADIOLYSIS OF GASEOUS CARBON DIOXIDE. Anderson, A. R.; Best, J. V. F. (Atomic Energy Research Establishment, Harwell, Eng.). Advan. Chem. Ser., No. 82, 231-46(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.2).

Measurements are described of the effects of added O_2, CO, and SF_6 on the proton irradiation of gaseous CO_2 and on the radiation-induced exchange of ^{14}C between ^{14}CO and CO_2. The oxidation of CO is enhanced by adding small concentrations of O_2 but is inhibited at higher concentrations of O_2 by increased dose rate on adding SF_6. The data are interpreted on the basis of two principal oxidizing species, the CO_3 radical and the negative ion O_2^-, which is in equilibrium with ions of higher molecular weight such as CO_4^-. Both the species, CO_3 and O_2^-, participate in the radiolysis of pure CO_2, but its apparent radiation stability is attributed primarily to oxidation of CO by the O_2^- ion. (auth)

47538 YIELDS OF THE REDUCING SPECIES IN THE VAPOR-PHASE RADIOLYSIS OF ISOPROPYL ALCOHOL AND WATER–ISOPROPYL ALCOHOL MIXTURES. Dixon, R. S.; Bailey, M. G. (Atomic Energy of Canada Ltd., Pinawa, Manitoba). Advan. Chem. Ser., No. 82, 247-65(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.2).

In the γ-radiolysis of water–isopropyl alcohol mixtures in the vapor phase, the total yields of hydrogen, methane, and carbon monoxide are linear over the whole concentration range, in the presence and absence of electron scavengers. The majority of the hydrogen produced from energy absorption by both water and isopropyl alcohol is formed by H-atom abstraction from isopropul alcohol. Part of the H-atom yield is formed by electron-positive ion neutralization and part by processes not involving electrons. As far as the formation of H atoms is concerned, both electron-positive ion and ion–ion neutralizations appear to be independent of the composition of the positive ion cluster. A yield of molecular hydrogen is also present in both water and isopropyl alcohol. (auth)

47539 PROPERTIES AND REACTIONS OF ELECTRONS IN γ-IRRADIATED AND PHOTOIONIZED ORGANIC GLASSES. Bonin, Michael A.; Lin, Jacob; Tsuji, Kozo; Williams, Ffrancon (Univ. of Tennessee, Knoxville). Advan. Chem. Ser., No. 82, 269-90 (1968).

The ways in which the radiation-induced generation and stability of trapped electrons in hydrocarbon glasses are affected by the presence of polar additives were studied by ESR and optical techniques. Adding 5 mole % triethylamine (TEA) enhances the radiation chemical yields; $G(e^-)$ is increased from 0.30 to 0.98 for methylcyclohexane, from 0.69 to 1.08 for 3-methylpentane, but only from 0.89 to 0.96 for 3-methylhexane. At higher TEA concentrations, the yield is reduced by incipient crystallinity effects. The presence of a polar substance retards thermal decay of the trapped electron after irradiation. Acetonitrile in methyltetrahydrofuran glass undergoes efficient dissociative electron capture to give methyl radicals on photobleaching after γ-irradiation. This reaction may involve resonance capture of the optically excited electron. (auth)

47540 IONIC PROCESSES IN γ-IRRADIATED 3-MP GLASS. Somogyi, I. Kosa; Balog, J. (Central Research Inst. for Physics, Budapest). Advan. Chem. Ser., No. 82, 291-9(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.2).

Studies of the electric conductivity as a function of temperature on gamma-irradiated 3-methylpentane glass are reported. During irradiation steady-state currents of 1.7×10^{-8} and 5.7×10^{-10} amp were measured at 290 and 77°K, respectively. The temperature dependence of the conductivity curves during warming reveals three populations of charge carriers which can be freed from traps to the conduction band at 77, 85 to 185, and 200°K. The two thermoluminescence intensity peaks observed at 100 and 163°K confirm charge migration in these temperature ranges, but no intensity peak appears at 77°K. (auth)

47541 RADIATION CHEMISTRY OF n-PENTANE IN THE SOLID PHASE. Bienfait, C.; Ceulemans, J.; Claes, P. (Univ. of Louvain, Belg.). Advan. Chem. Ser., No. 82, 300-10(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.2).

n-Pentane was irradiated in the solid phase at 77°K by ^{60}Co γ-rays to doses ranging from 1 to 12 Mrads. The concentration of dimers was measured by gas–liquid partition chromatography after melting the irradiated sample; the amount of unsaturated hydrocarbons was determined by bromine titration. The yields of these various products are independent of the absorbed dose. The following yield values were measured: G(dimer) = 0.56 molecules/100 eV, G(trimer) = 0.03 molecules/100 eV, and G(C=C) = 3.31 double bonds/100 eV. Dimer production arises from radical and ionic processes. Occurrence of ion–molecule reactions is proposed to explain the formation of trimers. Unsaturated compounds are formed by radical disproportionation or by molecular fragmentation. (auth)

47542 AN ELECTRON SPIN RESONANCE STUDY OF ENERGY TRANSFER IN THE γ-IRRADIATED SYSTEM BENZENE–SILICA GEL. Edlund, Ove; Kinell, Per-Olof; Lund, Anders; Shimizu, Akira (Swedish Research Council's Lab., Studsvik). Advan. Chem. Ser., No. 82, 311-26(1968).

Benzene–silica gel was irradiated at 77°K with ^{60}Co γ rays at a dose rate of 300 to 350 krads/hour. At a low benzene content the monomeric benzene cation is observed, while at higher concentrations the singly charged dimer is predominant. Cyclohexadienyl is formed from hydrogen atoms, radiolytically liberated from surface hydroxyl groups. The ions are created at other sites. At higher temperatures radical reactions occur between benzene and cyclohexadienyl or the positive ion. The dependency of the yields on the dose shows that only a limited number of sites, 7×10^{14} per sq meter. Brunauer–Emmett–Teller (BET) surface, is available for the oxidation of benzene. Cyclohexadienyl yields do not saturate to the same extent. The magnitude of energy transfer is estimated. (auth)

47543 SOME EFFECTS OF CRYSTAL STRUCTURE ON PRODUCTION OF RADICALS IN IRRADIATED ORGANIC CRYSTALS. Rogers, Max T.; Kispert, L. D. (Michigan State Univ., East Lansing). Advan. Chem. Ser., No. 82, 327-35(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.2).

A series of anhydrous and hydrated polycrystalline metal acetates was irradiated at 77°K with 1-MeV electrons and the ESR spectra observed. The principal stable free radical found in the hydrated materials is methyl whereas other species predominate in the anhydrous acetates and methyl radical is not observed or is only a minor product. The absolute yield of methyl radicals, as well as the ratio of methyl to other species, appears to increase with the number of molecules of water of crystallization. The radicals obtained by breaking C–C bonds are also found in irradiated sodium perfluorosuccinate hexahydrate and acetamide and it appears that such species may be favored in crystals whose structures are largely determined by hydrogen bonding. (auth)

47544 ION NEUTRALIZATION TIMES IN THE GAMMA OR ELECTRON RADIOLYSIS OF SEVERAL DIELECTRIC LIQUIDS WITH DIFFERENT DIELECTRIC CONSTANTS. Freeman, Gordon R. (Univ. of Alberta, Edmonton). Advan. Chem. Ser., No. 82, 339-50(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.2).

The recently developed nonhomogeneous kinetics model for the reaction of ions produced during radiolysis of dielectric liquids is applied to the estimation of the lifetimes of these ions in water, ethyl alcohol, acetone, and cyclohexane. Calculated lifetime spectra are given. The use of the complex dielectric constant in the calculations is discussed and found to be necessary for alcohols, but not for water, acetone, or hydrocarbons. The model predicts that the yield of ions observed at time t after an instantaneous pulse of radiation would be about 10% greater than G_{fi} at 0.3 nsec in water, 2 nsec in ethyl alcohol, 3 nsec in acetone, and 400 nsec in cyclohexane. The calculated results are consistent with the limited measurements that have been published. (auth)

47545 NANOSECOND PULSE RADIOLYSIS OF CARBON TETRACHLORIDE. Cooper, R.; Thomas, J. K. (Argonne National Lab., Ill.). Advan. Chem. Ser., No. 82, 351-60(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.2).

A positive ion of CCl_4 is observed in the nanosecond pulse radiolysis of pure CCl_4. The ion which has an absorption maximum at 4750 A, where ϵ is 2.34×10^4, shows an initial rapid first order decay, $t_{\frac{1}{2}} = 15 \pm 2$ nsec followed by a much slower decay over several μsec. The slow decay is 4% of the fast decay. Many solutes remove the positive ion forming solute positive ions with spectra in the visible which also exhibit a rapid and slow decay. At the same time, long-lived species are observed with absorptions towards the ultraviolet and these may be caused by Cl atom/solute complexes or free radicals. (auth)

47546 LIQUID-PHASE ION-MOLECULE REACTIONS: THE ION INJECTION METHOD APPLIED TO ISOBUTYLENE. Viswanathan, N. S.; Kevan, L. (Univ. of Kansas, Lawrence). Advan. Chem. Ser., No. 82, 361-77(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.2).

tert-Butyl carbonium ion is produced by vapor phase photolysis of isobutylene with a krypton resonance lamp. The tert-$C_4H_9^+$ is separated from its concomitant electron and injected into liquid isobutylene by an electric field. Only C_8 and C_{12} products are observed; the relative C_8 and C_{12} yields are dose dependent. The C_8 products are 2,2,4-trimethylpentane (4%); 2,4,4-trimethylpentene-2 (49%); 2,2,3-trimethylpentane (19%) and 3,4,4-trimethylpentene-2 (28%). Proton transfer is the most important neutralization step but hydride transfer also occurs. The tert-$C_4H_9^+$ is vibrationally excited and reacts equally at both double-bond carbons in isobutylene. Added argon deexcites tert-$C_4H_9^+$ which then primarily reacts at the terminal double-bond carbon in isobutylene. (auth)

47547 RATE CONSTANTS AND EQUILIBRIUM CONSTANTS FOR ELECTRON TRANSFER REACTIONS OF AROMATIC MOLECULES IN SOLUTION. Arai, Shigeyoshi; Dorfman, Leon M. (Ohio State Univ., Columbus). Advan. Chem. Ser., No. 82, 378-86(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.2).

Absolute rate constants for electron transfer of aromatic molecules in solution were determined by the pulse radiolysis method for three pairs of aromatic compounds. In two of these cases in which an electron transfer equilibrium is established, the rate constant for the back reaction was also determined. The equilibrium constant was estimated from the kinetic data. A correlation of the experimental rate constants with the theory for homogeneous electron transfer rates is considered. (auth)

47548 EXCITED STATES IN IRRADIATED AROMATIC SOLVENTS. Cundall, R. B.; Tippett, W. (Univ. of Nottingham, University Park, Eng.). Advan. Chem. Ser., No. 82, 387-400(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.2).

The radioinduced cis–trans isomerization of 2-butene in benzene, benzene-d_6, toluene, and pyridine was studied. The triplet yield in benzene is 4.7 molecules per 100 eV; benzene-d_6 is similar. The yield in toluene is ~6 molecules per 100 eV. Nitrous oxide reduces the isomerization yield by about 40%. This indicates a G value of about 2 for excited states produced by the recombination of benzene ions with electrons. Xenon and krypton (up to 1M) increase the isomerization yield from 2.4 to 3.1 and 2.9 respectively, whereas argon has no effect. From the effect of xenon,

which is attributed in part to enhanced intersystem crossing, it is estimated that the yield of singlet states which do not cross to the triplet in unperturbed benzene solutions is 1.3 molecules per 100 eV. (auth)

47549 MECHANISMS OF DEFERRED LUMINESCENCE IN ORGANIC SOLIDS AFTER γ-IRRADIATED AT 77°K. Deroulede, A.; Kieffer, F.; Magat, M. (Laboratoire de Physico-Chimie des Rayonnements, Orsay, France). Advan. Chem. Ser., No. 82, 401-11(1968).

The technique of radiophotoluminescence excitation spectra is used to study the displacement of electrons from physical traps to solute molecules and vice-versa in solutions of biphenyl in methylcyclohexane. Bleaching in the infrared leads to the disappearance of trapped electrons and of the first peak of radiothermoluminescence. If a bleached sample is illuminated in one of the two biphenyl anion absorption bands, both infrared-stimulated RPL and a weak first glow peak reappear. It is concluded that of the two RTL peaks observed at 90 and 95°K in methylcyclohexane glass, the first is caused by recombination of electrons with solute cations and the second by diffusion and recombination of solute anions and cations. (auth)

47550 IONIC REACTIONS IN ETHYL CHLORIDE. Tiernan, Thomas O.; Hughes, B. Mason (Aerospace Research Labs., Wright-Patterson Air Force Base, Ohio). Advan. Chem. Ser., No. 82, 412-40(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.2).

Ion–molecule reactions in gaseous ethyl chloride are identified by detailed mass spectrometric investigation. The majority of these reactions lead ultimately to a single unreactive ionic product, $C_4H_{10}Cl^+$, which constitutes about 70% of the total ionic yield at a system pressure of 1000 μ. From the radiolysis products of ethyl chloride and of ethyl chloride with various additives, the ionic fragmentation scheme is deduced at the higher pressures used. Ion-scavenging techniques are used to characterize unreactive ions in the radiolysis system. The product distribution resulting from excited ethyl chloride molecule decomposition is derived from related photolysis studies and is used in conjunction with data obtained for the other reaction processes to construct a complete mechanism for the radiolytic decomposition. (auth)

47551 THE H/D ISOTOPE EFFECT IN THE RADIOLYSIS OF HEXANE. Gaeumann, Tino; Reipso, Bonzo (Institut de Chimie-Physique, Lausanne, Switzerland). Advan. Chem. Ser., No. 82, 441-55(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.2).

The radiolysis of the protiated and the deuterated form of n-hexane and mixtures thereof was examined as a function of temperature and at one N_2O-concentration. A strong isotope effect can be observed for fragmentation giving hexene and hydrogen by a unimolecular process, whereas the other product distribution is not much affected by deuteration. N_2O does not decrease the primary formation of C_6D_{13}-radicals in mixtures. A novel reaction type is proposed for these systems giving hexene and water in a unimolecular step. (auth)

47552 THERMAL ELECTRON ATTACHMENT STUDIES BY THE PULSE-SAMPLING TECHNIQUE. Wentworth, W. E.; Steelhammer, Joe C. (Univ. of Houston, Tex.). Advan. Chem. Ser., No. 82, 75-100(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.2).

Both dissociative and nondissociative thermal electron attachment processes were studied utilizing the pulse-sampling technique. From these studies the following molecular parameters may be derived: molecular electron affinities, rate constants for dissociative and nondissociative thermal electron attachment, electron affinities of radicals, bond dissociation energies, and activation energies for electron attachment, detachment, and dissociation. Although this mode of electron attachment differs from that in electron swarm and beam studies, the results appear to be in agreement and are quite complementary in elucidating negative ion formation and reaction. (auth)

47553 THE RADIOLYSIS OF METHANE IN A WIDE-RANGE RADIOLYSIS SOURCE. Rudolph, P. S. (Oak Ridge National Lab., Tenn.). Advan. Chem. Ser., No. 82, 101-19(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.2).

The radiolysis of methane was studied in a new type of three-stage wide-range radiolysis source attached to a research mass spectrometer. This source gave direct evidence of the various ionic and non-ionic reactive primary species, and by applying an electric field, it gave evidence of their relative roles in producing stable products. Under experimental conditions that minimized subsequent reactions of reactive stable products (i.e., flow, low pressure, and localized ionization) it was found that the abundance of the unsaturated hydrocarbons produced in the radiolysis of methane was about three times the abundance of the saturated hydrocarbons. Threshold energy curves were determined which give valuable information as to the precursors of the various products. G values for the various products were calculated, and reaction mechanisms are postulated. (auth)

47554 THE X-RADIOLYSIS OF PERFLUOROCYCLOBUTANE AND MIXTURES OF PERFLUOROCYCLOBUTANE AND METHANE IN THE GAS PHASE. Heckel, Edgar; Hanrahan, Robert J. (Univ. of Florida, Gainesville). Advan. Chem. Ser., No. 82, 120-33(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.2).

The x radiolysis of perfluorocyclobutane in the gas phase consists of a combination of fragmentation and telomerization processes. More than 10 products were noted with chain lengths from C_5 to C_{14}, as well as C_2F_4, C_3F_6, C_3F_8, and a white polymer. Even-carbon exceeded odd-carbon products by two-fold. The radiolysis was not affected by added N_2O, but all heavier fluorocarbon products were eliminated by added O_2. With added CH_4 no products having more than five carbon atoms were found. It is postulated that the radiolysis of perfluorocyclobutane proceeds along three major paths: direct decomposition, giving two molecules of tetrafluoroethylene; a process giving perfluorocyclobutyl radicals plus fluorine atoms; and a process giving C_1 and C_3 species. The radicals then initiate a short chain polymerization of tetrafluoroethylene. (auth)

47555 VAPOR-PHASE γ-RADIOLYSIS OF BENZENE, TOLUENE, ETHYLBENZENE, AND THE XYLENES. Wilzbach, K. E.; Kaplan, Louis (Argonne National Lab., Ill.). Advan. Chem. Ser., No. 82, 134-41(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.2).

Benzene, toluene, ethylbenzene, and the three xylenes were irradiated in the vapor phase with gamma rays. Products and yields were compared with those in liquid-phase radiolysis. G values for disappearance in the vapor phase range from 6 to 10, more than five times greater than in the liquid phase. The principal product in each case is "polymer." All of the identified products are also found in the liquid phase, but relative yields are markedly different. The high yields of acetylene and some other products in the vapor phase suggest that ionic processes are more important here than in the liquid phase. (auth)

47556 A PULSED-RADIOLYSIS STUDY OF THE GAS-PHASE REACTION OF OXYGEN ATOMS WITH BENZENE AND RELATED COMPOUNDS: RATE CONSTANTS AND TRANSIENT SPECTRA. Mani, Inder; Sauer, Myran C. Jr. (Argonne National Lab., Ill.). Advan. Chem. Ser., No. 82, 142-52(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.2).

Pulsed-radiolysis of gas-phase systems containing CO_2 or N_2O results in the production of oxygen atoms, which are in the triplet ground state. In the presence of small amounts of benzene, for example, an optical absorption is found to be formed after the pulse, with a maximum at 275 mμ and a shoulder in the region of 300 mμ. Similar absorption spectra are found for other compounds. Rate constants for the process $O(^3P) + X \rightarrow$ products are, where the compound X is given in parentheses and the rate constant is in units of 10^8 liter mole^{-1} sec^{-1}, 0.36 (benzene), 1.4 (toluene), 3.2 (ethylbenzene), 6.7 (o-xylene), 7.7 (m-xylene), 4.5 (p-xylene), 3.1 (chlorobenzene), 0.27 (fluorobenzene), and 1.0 (pyridine). The estimated limits of error are about ±25%. (auth)

47557 DIPOLE EFFECTS ON HYDROGEN ATOM TRANSFER IN ION-MOLECULE REACTIONS. Meisels, G. G.; Leger, L. J. (Univ. of Houston, Tex.). Advan. Chem. Ser., No. 82, 153-62 (1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.2).

Proton and hydrogen atom transfer was investigated in the methanol–acetaldehyde system. Combinations of CH_3OH, CD_3OH, CH_3CHO, CD_3CDO, CD_3CHO, and CH_3CDO were employed to allow evaluation of the position from which the transfer occurs, and the ratio plot method (variation of ionizing voltage near the onset of methanol-ion formation) was used to distinguish between proton and hydrogen atom transfer. Proton transfer appears to be determined chiefly by the energetics of the competitive processes, while hydrogen atom transfer is favored from the acetyl and hydroxyl groups by a factor of 3. (auth)

47558 ESR STUDIES OF FREE RADICALS CONDENSED FROM VAPORS OF ACETONE, ETHYLENE, METHYL ALCOHOL, ETHYL ALCOHOL, AND tert-BUTYL ALCOHOL AFTER IRRADIATION BY 1-MeV He^+ IONS. Seddon, W. A.; Smith, D. R. (Atomic Energy of Canada, Ltd., Chalk River, Ont.). Advan. Chem. Ser., No. 82, 163-75(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.2).

Paramagnetic species, generated in the vapor phase in a "crossed-beam" experiment by irradiation with 1-MeV He^+ ions, were trapped at 77°K and detected by electron spin resonance (ESR). The results obtained from irradiated methyl, ethyl, and tert-butyl alcohol, acetone, and ethylene are described. Trapped electrons together with the radicals $\cdot CH_2OH$, CH_3CHOH, and $(CH_3)_2C(OH)CH_2\cdot$ and $(CH_3)_3C\cdot$ are formed in methyl, ethyl, and tert-butyl alcohol respectively. Ethyl radicals are formed from ethylene. Acetone gives rise to $CH_3COCH_2\cdot$ and CH_3 radicals and appears to form trapped electrons in the deposit. The results are compared with the radiation chemistry of these systems in the solid and vapor phase. (auth)

47559 PROCEDURE FOR THE PREPARATION OF SAMPLES FOR ALPHA SPECTROMETRY DEVELOPED BY THE PLUTONIUM CHEMISTRY GROUP AND THE OFFICE OF CHEMISTRY AND ISOTOPES. Acena Barrenechea, M. L. (Junta de Energia Nuclear, Madrid). pp 83-92 of Traitement des Combustibles Irradies. Fontenay-aux-Roses, Centre d'Etudes Nucleaires, [1968]. (In Spanish).

From 1st Franco-Spanish Colloquium on the Processing of Irradiated Fuels, Fontenay-aux-Roses, France. See CONF-671143.

A description is given of the methods used for the preparation by electrochemical deposition of some alpha sources to be used in spectrometry. Two processes, in general, have produced the best results. In the first method, specific for uranium, in fluoride medium, there are obtained homogeneous layers adhering to stainless steel electrodeposited quantitatively. The other method, equally quantitative, serves to deposit electrochemically, on polished refractory steel, fine homogeneous layers of various 5f elements. Experiments were carried out with U, Th, Pu, Am, and Np for activities between 10 and 5×10^4 dpm. The electrolyte can be either HNO_3 or HCl. The best conditions for the two processes and the type of electrolytic cells used are described as well as some results obtained in spectrometry with these sources. (tr-auth)

47560 RADIATION CHEMISTRY. VOLUME I. AQUEOUS MEDIA, BIOLOGY, DOSIMETRY. An International Conference, Argonne National Laboratory, Argonne, Ill., Aug. 12-15, 1968. Gould, Robert F. (ed.). Advances in Chemistry Series 81. Washington, D. C., American Chemical Society, 1968. 634p. (CONF-680806-(Vol.1)).

An abstract was prepared for each of the forty-one papers in this volume. Abstracts of seventeen oral presentations are also included in the volume. (D.H.M.)

For abstracts of individual papers see: 47440, 47498–47517, 47519–47533, and 47849–47853.

47561 INTERNATIONAL SYMPOSIUM ON MACROMOLECULAR CHEMISTRY, BRUSSELS-LOUVAIN, JUNE 12-16, 1967. PART 2. Mark, H.; Overberger, C. G.; Fox, T. G. (eds.). J. Polym. Sci., Part C, No. 22, 547-1209(1969). (In several languages). (CONF-670650-(Pt.2)).

Fifty-one papers covering polymerization and properties of polymers presented at the conference are included. A separate abstract was prepared for one paper. (M.C.G.)

For an abstract of the individual paper see: 47562.

47562 DIFFUSIONAL EFFECTS IN RADIATION-INDUCED GRAFT POLYMERIZATION. Odian, George; Kruse, Robert L. (Columbia Univ., New York). J. Polym. Sci., Part C, No. 22, 691-712(1969).

From International Symposium on Macromolecular Chemistry, Brussels-Louvain, Belgium. See CONF-670650-(Pt.2).

Various theoretical equations were derived to show the effects of diffusion on steady-state radioinduced graft polymerization. The theoretical relationships describe the effects of diffusion on the grafting reaction in terms of the change in the reaction from volumetric to surface grafting, the effect of polymer film thickness on the rate of grafting, and the order of the dependence of the rate on the radiation intensity. A mathematical analysis is presented in terms of the quantitative interrelationships of the quantities $^{1}/_{2}k_p/k_t$, I (the radiation intensity), D (the diffusivity of the monomer in the polymer), and l (the polymer film thickness). The theoretical equations show the exact manner in which these quantities interact to determine the grafting rate. Experimental data are presented for the graft polymerization of styrene-acrylonitrile to high-density polyethylene films 1.1 to 40 mils thick at dose rates of 0.005 to 8.5 Mrad/hr. The experimental results are shown to confirm the theoretical relationships quite well. Thus, appropriate experimental plots such as those of $\log \bar{R}_p/I^{1/2}$ versus $\log l^{1/2}l$ and $\log \bar{R}_p l^2$ versus $\log ll^4$ follow the same form as the theoretical relationships. The utility of these plots is discussed, as is the applicability of the derived theoretical relationships to all grafting systems. (auth)

47563 SEPARATION OF ^{132}Te AND ^{132}I. Kulesza, Albin (Inst. for Nuclear Studies, Swierk, Poland). Nukleonika, 14: 537-42(1969). (In Polish).

The separation of ^{132}Te from fission products as well as separation of ^{132}I from ^{132}Te in a chromatographic column using a Al_2O_3 filter is described. The preparation of ^{132}I generators is also described as well as the method of the separation of ^{99}Mo from ^{132}Te impurities using coprecipitation of tellurite with an Al_2O_3 column. (auth)

47564 EFFECT OF GAMMA RADIATION ON ION EXCHANGE RESINS. I. IRRADIATION DAMAGE OF FUNCTIONAL GROUPS IN THE STRONG BASE ANION EXCHANGE RESIN ZEROLIT FF-IP. Basinski, Antoni; Narebska, Anna; Tempczyk, Maria (Univ., Torun, Poland). Nukleonika, 14: 509-19(1969).

Investigations of the radiation damage of functional groups in the strong base anion exchange resin Zerolit FF-IP in chloride form were carried out. It was found that during irradiation the functional groups in this form are split off, but not degradated. The yields of irradiation reaction taking place in Zerolit FF-IP irradiated in the dry and wet states were calculated, and the contribution of water to the damage of functional groups of the resin were evidenced. (auth)

47565 THE KINETICS OF OXIDATION OF FERROCYANIDE AND REDUCTION OF FERRICYANIDE IONS BY γ RAYS. Sobkowski, Jerzy (Univ. of Warsaw). Nukleonika, 14: 253-9 (1969).

γ-Radiative oxidation of ferrocyanide and reduction of ferricyanide ions were investigated with particular reference to post-radiation effects due to the slow reaction with hydrogen peroxide. Measurements were made at various hydrogen ion concentrations in the presence and absence of dissolved oxygen. A mechanism of the reaction is suggested. (auth)

47566 GAMMA RADIOLYSIS OF A NITROGEN–ETHYLENE GASEOUS MIXTURE. Gawlowski, Janusz; Bierzynski, Andrzej; Niedzielski, Jan (Univ. of Warsaw). Nukleonika, 14: 381-6 (1969). (In Polish).

Gaseous nitrogen–ethylene mixtures containing 5, 15, and 20% C_2H_4 were irradiated in γ ^{60}Co source under a pressure dose to normal and at room temperature. The total dose absorbed as measured by a N_2O dosimeter was 20 Mrad. The sharp increase of the radiolytic yields with increasing nitrogen concentration was ascribed to the nitrogen sensibilization. Nitrogen containing compounds were sought but not found. The mechanism of formation of some radiolytic products was suggested. (auth)

47567 CHEMICAL EFFECTS OF THE NEUTRON ACTIVATION OF SOME RHENIUM COMPOUNDS. Facetti, Juan F.; de Santiago, Marcelina V.; Wheeler, Owen H. (Puerto Rico Nuclear Center, Mayaguez. Instituto de Ciencias, Asuncion, Paraguay). Radiochim. Acta, 12: 82-5(Aug. 1969).

The distribution of the 3, 4, and 7 valence states of ^{186}Re and ^{188}Re recoil atoms formed in neutron-irradiated ReO_2, Re_2O_7, and NH_4ReO_4 have been studied. Annealing showed that the composition and structures of the compounds determined the radiochemical yield of Re(VII). (auth)

47568 CONCERNING THE LET PARAMETER AND THE RADIOLYSIS OF SOLUTIONS OF Fe^{2+} BY PROTONS OF LOW ENERGY. Pucheault, J.; Julien, R. (Laboratoire Curie, Paris). Radiochem. Radioanal. Lett., 2: 27-31(Sept. 26, 1969). (In French).

The radiolysis of solutions of iron(II) sulfate by accelerated protons with energies in the range of 30 to 400 keV was studied. (auth)

47569 PREPARATION OF ^{123}I BY α PARTICLE BOMBARDMENT OF NATURAL ANTIMONY. Silvester, D. J.; Sugden, J.; Watson, I. A. (Hammersmith Hospital, London). Radiochem. Radioanal. Lett., 2: 17-20(Sept. 26, 1969).

Relative yields of ^{123}I, ^{124}I, ^{125}I, and ^{126}I were measured in natural antimony targets bombarded by α beams of 21.1 to 30.0 MeV. After 60 minutes bombardment at 25.1 MeV, the yield of ^{123}I in a 17 mg/cm^2 target was about 150 μCi/μAh, and the ^{124}I activity was about 0.7% of the ^{123}I activity. (auth)

47570 CHEMICAL INVESTIGATIONS OF THE MOLECULAR ORIGIN OF BIOLOGICAL RADIATION DAMAGE. Fahr, E.

(Univ., Wuerzburg, Ger.). Angew. Chem. Int. Ed. Engl., 8: 578-93(Aug. 1969).

A review is presented on studies dealing with the radiation damage observed when uv and ionizing radiations react on biological objects and caused in many cases by changes in the nucleic acids. Exposure of these compounds to uv radiation in vitro and in vivo leads, inter alia, to dimerization of the pyrimidine bases with formation of cyclobutane derivatives, and to addition of water to the 5,6-double bond of the pyrimidine bases to form derivatives of the 6-hydroxyhydropyrimidine system. The structure of the irradiation products has been established. The dimerization prevents the reduplication of the DNA, and the addition of water appears to be the cause of uv mutations. Ionizing radiation in aqueous solution results, e.g., in addition of H and/or HO radicals to the 5,6-double bond of the pyrimidine bases and cleavage of the imidazole ring of the purine bases. The mutations caused by ionizing radiation are probably also due, in part, to the formation of 6-hydroxydihydropyrimidine derivatives. (auth)

47571 EQUILIBRIA IN SOLUTIONS AND ANION EXCHANGE OF URANIUM(VI) COMPLEXES. I. ABSORPTION SPECTRA OF URANIUM(VI) COMPLEXES IN CARBONATE SOLUTIONS. Majchrzak, Kazimierz (Inst. for Nuclear Studies, Warsaw). Nukleonika, 14: 543-8(1969). (In Polish).

The absorption spectra (400 to 500 mμ) of uranium(VI) in carbonate solutions were investigated. It was found that when the carbonate ($H_2CO_3 + HCO_3^- + CO_3^{2-}$) to uranium concentration ratio is higher than 3, only one complex ion is present, probably of the form $[UO_2(CO_3)_3]^{4-}$. When the concentration ratios are lower, the uranyl ion hydrolyzes. (auth)

47572 MASS SPECTROMETRIC STUDIES OF ION-MOLECULE REACTIONS IN BINARY SYSTEMS. III. REACTIONS IN OLEFIN–ND_3 SYSTEMS. Wincel, Henryk; Michalska, Krystyna (Inst. of Nuclear Research, Warsaw). Nukleonika, 14: 365-80(1969).

The ion–molecule reactions occurring in C_2 to C_5 olefin–ND_3 mixtures were investigated. Several proton transfer reactions leading to ND_3H^+ production were observed and their rate constants were measured. Charge transfer processes from ND_3^+ to C_2 to C_5 olefin neutral molecules as well as from $C_3H_7^+$ to ND_3 were observed, while those from ND_3^+ to C_2 to C_5 olefin neutrals did not occur with measurable probabilities. The results were interpreted on the basis of Massey and Burhop's adiabatic hypothesis. Kinetic energy transfer to internal energy is involved for the peculiar velocity dependence in the $ND_3^+–C_2H_4$ interaction. It was found that the rate constants for disappearance of doubly charged ions in reactions with ND_3 are much higher than average rate constants for singly charged ions. The significance of observed ionic processes in the gas phase radiolysis of olefin–ammonium mixtures was discussed. (auth)

47573 ^{35}S AND ^{32}P PRODUCTS FORMED IN THE NEUTRON ACTIVATION OF AROMATIC SULFUR COMPOUNDS. Wheeler, Owen H.; Gonzalez, Carmen L.; Facetti, Juan F. (Puerto Rico Nuclear Center, Mayaguez). Radiochim. Acta, 12: 79-82(Aug. 1969).

The inorganic and organic acid activities formed in the neutron activation of diphenyl sulfide, sulfoxide and sulfone were analyzed. The higher oxygenated compounds tend to form more oxygenated products. The "retention" in all cases was small. (auth)

47574 THEORETICAL STUDY OF THE STRUCTURE OF A RADICAL OBTAINED BY THE γ-IRRADIATION OF CYTOSINE. Ray, N. K. (Johns Hopkins Univ., Baltimore). Mol. Phys., 17: 305-6(1969).

The results of spin density calculations for the two possible structures (shown graphically) of this radical are presented, with the aim of assigning the correct structure. The unrestricted Hartree–Fock method was employed for obtaining the π-electron spin density matrix. Comparison is made with results for the cyclohexadienyl radical. (UK)

47575 NORMAL BEHAVIOUR OF SCAVENGERS IN RECOIL TRITIUM REACTIONS. Baker, R. T. K.; Wolfgang, Richard (Yale Univ., New Haven. Univ. of Colorado, Boulder). Trans. Faraday Soc., 65: 1842-5(July 1969).

Certain apparent anomalies, first reported by Urch and Welch, (Trans Faraday Soc. 62: 388 (1966)) concerning the effects of scavengers on recoil tritium reactions were examined. Their existence was confirmed, but their origin appeared to be due simply to the incomplete control of thermal processes. These effects do not therefore imply any complex or significant involvement of scavengers in hot processes. (auth) (UK)

47576 THERMAL ANNEALING OF CRYSTALLINE RHENIUM COMPOUNDS IRRADIATED WITH 660 MeV PROTONS. Ianovici, Eugenia; Zaitseva, Natalia (Joint Inst. for Nuclear Research, Dubna, USSR). J. Inorg. Nucl. Chem., 31: 2669-77(Sept. 1969).

The thermal annealing of crystalline sodium and ammonium perrhenates and potassium hexachlororhenate(IV) irradiated with 660-MeV protons was studied. The isothermal curves obtained for sodium and ammonium perrhenates show the existence of competing reduction and oxidation reactions in the annealing process. Classical isothermal annealing curves were obtained for potassium hexachlororhenate(IV). The thermal annealing process involves the reduction of radiorhenium to the parent form. It is shown that the annealing behavior of radiorhenium obtained by high energy proton or neutron irradiation is practically the same. (auth) (UK)

47577 THIN LAYER CHROMATOGRAPHY AS A METHOD FOR INVESTIGATION OF RADIATION CHANGES IN ADSORBENTS AND ADSORBATES. II. INVESTIGATION OF RADIOCATALYTIC PROCESSES ON THE EXAMPLE OF DIPHENYLAMINE. Nowak, Zofia (Inst. of Nuclear Research, Warsaw). Chem. Anal. (Warsaw), 14: 777-84(1969). (In Polish).

A modified thin-layer chromatographic method has been used for the investigation of radiocatalytic processes. Modification of the method included simultaneous layering of the oxides on the plates on which radiolysis was carried out as well as those oxides which were used as stationary phases for chromatographic separations. This method was used to study the radiolysis of diphenylamine as a function of the kind of oxide used as an adsorbent, and the results were compared with the radiolysis of diphenylamine not bound to an adsorbent. It was found that considerable decomposition of diphenylamine occurs during heterogeneous radiolysis with the formation of various derivatives depending on the kind of adsorbent on which diphenylamine was irradiated. (auth)

47578 PRODUCTION OF HIGH PURITY RADIOACTIVE ^{99m}Tc. Arino, Hirofumi (to Union Carbide Corp.). U. S. Patent 3,468,808. Filed June 16, 1967.

Pure technetium-99m is obtained by a process which comprises selectively extracting technetium-99m from a slurry of its radioactive parent, molybdenum-99, deposited on oxidized, hydrous zirconium oxide. (Offic. Gaz.)

Radiochemistry

Refer also to abstracts 47372, 47480, and 48007.

47579 POSITRONIUM CHEMISTRY. AN INTRODUCTION. Khan, M. N. G. Azam (Univ. of New South Wales, Kensington). Nucleus (Lahore), 5: 87-90(July-Dec. 1968).

Research in positronium formation and its various reactions is discussed. As an ultralight hydrogen-type atom, a "model" free radical, positronium represents a "tagged atom." Its properties depend primarily upon the properties of the surrounding medium. The brief natural lifetime of positronium serves as a quite suitable time standard in investigating short-time processes characteristic of the condensed phase. (auth)

Separation Processes

Refer also to abstracts 47385, 47402, 47422, 47563, 47578, 47657, 47721, 47723, 47727, 47784, 48321, 48370, 48396, and 48464.

47580 (ARH-SA-39) CONTINUOUS INCINERATION OF PLUTONIUM-BEARING SCRAP. Knights, Lee M. (Atlantic Richfield Hanford Co., Richland, Wash.). Sept. 15, 1969. 12p. (SM-125/62; CONF-691008-1). Dep. CFSTI.

From Symposium on Radiation Safety Problems in the Design and Operation of Hot Facilities, Saclay, France.

Incineration and leaching equipment were built and operated for plutonium recovery from scrap from the Purex Process. Equipment and controls, safety considerations, maintenance, and performance are discussed. (M.C.G.)

47581 (ARH-SA-51) TREATMENT OF HANFORD NUCLEAR FUELS PROCESSING WASTES TO PERMIT LONG-TERM STORAGE. Larson, D. E.; Smith, P. W. (Atlantic Richfield Hanford Co., Richland, Wash.). Aug. 4, 1969. Contract AT(45-1)-2130. 20p. (CONF-690819-1). Dep. CFSTI.

From 66th National Meeting of the American Institute of Chemical Engineers, Portland, Ore.

A waste management program was adopted for immobilizing essentially all of the Hanford radioactive wastes. This program contains the following elements: remove and encapsulate long-lived heat emitters for long-term, on-site storage as salts in capsules; and evaporate residual salt waste to solid cakes in existing waste

tanks after allowing short-lived heat emitters to decay. Processing technology is described for removal of cesium and strontium from bulk salt wastes, producing cesium and strontium product suitable for final purification and encapsulation, and waste residues amenable to in-tank solidification to salt cakes. (M.C.G.)

47582 (BNWL-SA-1945) ION EXCHANGE: A GENERIC NUCLEAR INDUSTRY PROCESS FOR THE RECOVERY AND FINAL PURIFICATION OF Am, Cm, Pm, Sr, Pu, Np, Cs, Tc, Rh, AND Pd. Wheelwright, E. J. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Oct. 1968. Contract AT-(45-1)-1830. 19p. (CONF-690712-1). Dep. CFSTI.

From International Conference on Ion Exchange in the Process Industries, London, England.

The versatility of a shielded ion-exchange facility operated adjunct to a reactor fuel reprocessing plant is discussed. The feasibility and economic advantage of using such a processing facility for campaign recovery and purification of a large number of valuable elements is pointed out, and several separations flowsheets are briefly reviewed. (auth)

47583 (CONF-690532-(Abstr.)) 5th RADIOCHEMICAL CONFERENCE, ZVIKOV-CASTLE, CZECHOSLOVAKIA, MAY 19-24, 1969. Abstracts of Papers. 47p.

Abstracts of papers presented at the conference are grouped under the following topics: solvent extraction chemistry, ion exchange chemistry, and radiochemical separations and analyses. (M.C.G.)

47584 (COO-499-21) SPECIFIC ATTRACTIONS IN ION EXCHANGE. Final Report. Walton, Harold F. (Colorado Univ., Boulder). Sept. 24, 1969. Contract AT(11-1)-499. 5p. Dep. CFSTI.

Attempts are being made to develop better methods of automatic column monitoring in liquid chromatography. Methods were developed for cation-exchange separation of silver from lead. Ligand-exchange chromatographic techniques were developed for drugs derived from phenethylamine. (M.C.G.)

47585 (KFK-976) RECOVERY OF BY-PRODUCT ACTINIDES FROM POWER REACTOR FUELS. Koch, G. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Heisse Chemie). May 1969. 20p. (CONF-690426-1). Dep. CFSTI (U. S. Sales Only).

From Symposium on Transuranium Element Chemistry, Liege, Belgium.

The amounts of Np, Am, and Cm produced in power reactors are discussed. Separation of these elements from spent fuels is considered and their behavior in the Purex Process investigated. (M.C.G.)

47586 (KFK-990) FLOWSHEET STUDIES ON PROCESSING OF PLUTONIUM FUELS BY SOLVENT EXTRACTION. Koch, G.; Ochsenfeld, W.; Schwind, E. (Kernforschungszentrum, Karlsruhe (West Germany). Insitut fuer Heisse Chemie). May 1969. 21p. (CONF-690535-1). Dep. CFSTI (U. S. Sales Only).

From IAEA Panel on Reprocessing of Highly Irradiated Fuels, Vienna, Austria.

Solvent extraction flow sheets for plutonium recovery in the Purex Process are summarized. The interdependence of U and Pu distribution coefficients, countercurrent contactor studies, use of U(IV) as a reductant for Pu, direct electrolytic reduction of Pu, and recovery of Pu from fuel fabrication scrap are discussed. (M.C.G.)

47587 (ORNL-TM-2689) CHEMICAL APPLICATIONS OF NUCLEAR EXPLOSIONS (CANE): PROGRESS REPORT FOR APRIL 1-JUNE 30, 1969. Arnold, W. D.; Crouse, D. J. (comps.) (Oak Ridge National Lab., Tenn.). Aug. 25, 1969. 16p. Dep. CFSTI.

The ^{106}Ru concentration of cement copper was not significantly affected by changes in the leach liquor pH or in the oxidation state of the iron in the liquor. Both ^{185}W and ^{125}Sb were strongly adsorbed from a simulated leach liquor onto copper ore tailings and both cemented to some extent with the copper in batch cementation tests. Cementation of the antimony decreased as the antimony concentration in the liquor was decreased. The tritium contamination of oil retorted from Green River oil shale increased only slightly when the pressure during exposure of the shale to tritiated water vapor was increased from 160 to 860 psig. Construction of the apparatus for analysis of natural gas samples was almost completed and calibration of the system was started. (auth)

47588 URANIUM AS BY-PRODUCT OF COPPER LEACHING. S. Afr. Mining Eng. J., 80: 445(Feb. 28, 1969).

Leach solutions at all but a few Cu mines carried from 2 to 15 ppM U_3O_8 as equilibrium concentrations. Perhaps 1000 tons of U_3O_8 could be recovered annually from leach solutions at a cost of less than $8/lb by using a combination ion exchange and solvent extraction process developed by the U. S. Bureau of Mines. In a test run the column was tested over a 6-week period using strong base anion coarse-bead resins. The feed solution was effluent from the cementation launders running at 12 ppM U_3O_8, pH 3.4 to 3.5 and 90°F. The loaded resin was eluted in a countercurrent regeneration column using H_2SO_4. A strength of 1.5 M H_2SO_4 gave residual U_3O_8 loading of 0.37 g/l. About 1200 gal of pregnant eluate was produced with a U_3O_8 content of 2.5 to 40 g/l. The calculated U recovery was 80.5%. Laboratory tests showed that 4 or 5 stages of solvent extraction are required to strip the eluate using 5% tertiary alkyl amine plus 2% isodecanol dissolved in kerosene. The preferred stripping agent is 1M $(NH_4)_2SO_4$; only 2 stages are then required at pH 4.3 ± 0.1 by the continuous addition of NH_3. A continuous extraction system was established in which 180 gal of solution containing 2.42 g/l U_3O_8 was processed to give a concentrate of 4 lb of U_3O_8 in 13 gal solution. The U was recovered by precipitation with NH_3 and calcined to give an AEC specification material at 98.4% U_3O_8. Chemical consumption in the extraction process was (per lb of oxide) 0.62 lb NH_3, 1.5 lb H_2SO_4, and 0.004 gal solvent. (BBB)

47589 PRODUCTION OF THORIUM CONCENTRATE FROM POOR THORIUM BEARING ORES (<0.2% Th). Szymanska, Danuta (Zeran Inst. of Nuclear Studies, Poland). Nukleonika, 14: 175-9 (1969). (In Polish).

The conditions for the production of thorium concentrate (34 to 39% Th) from low-thorium-bearing ores have been developed. A high yield of thorium at a lowest possible consumption of H_2SO_4 has been obtained by the recirculation of the leaching solutions after adjusting their pH to 0.3 to 0.35. The leaching temperature was 85°C. (auth)

47590 RECOVERY OF ADDED NITROGEN FROM GAMMA-IRRADIATED SOILS. Singh, B. R.; Agarwal, A. S.; Kanehiro, Y. (Univ. of Hawaii, Honolulu). Soil Sci., 108: 85-8(Aug. 1969).

The recovery of added 200 ppM NH_4- and NO_3-N from five Hawaiian soils, Akaka, Wahiawa, Paaloa, Koko, and Lualualei, was studied following gamma irradiation with 3 Mrads. In addition, the study of the interaction of gamma irradiation and lime on the recovery was also included. Almost complete recovery of added NH_4- and NO_3-N was obtained from unirradiated soils. Following irradiation, the recovery of added NH_4-N from the Koko and Lualualei (two high pH soils) and NO_3-N from all the soils was decreased appreciably. Similarly, about 100 per cent recovery from limed, unirradiated soils was obtained. All the irradiated soils showed a decreasing NH_4-N and an increasing NO_3-N recovery pattern with increasing liming rates. (auth)

47591 SOLVENT EXTRACTION STUDIES BY THE AKUFVE METHOD. PART 1. PRINCIPLE AND GENERAL PROBLEMS. Rydberg, Jan. (Chalmers Univ. of Tech., Goteborg). Acta Chem. Scand., 23: 647-59(1969).

AKUFVE is an apparatus for the continuous measurement of the distribution factor of a solute in liquid-liquid extraction. It consists mainly of a mixer, a centrifuge for absolute phase separation and on-line detectors, which are either connected in a once-through or in a closed-cycle arrangement. The general properties and possible uses of the AKUFVE are discussed. Experimental results will be given in subsequent papers. (auth) (Denmark)

47592 PURIFICATION OF WASTE SOLUTIONS FROM FLUORINE. Petrova, T. N.; Bakhurov, V. G. At. Energ. (USSR), 26: 552-3(June 1969). (In Russian).

The solutions had a high content of nitrate (100 g/l), sulfate (13 to 37 g/l), fluoride (0.05 to 1.0 g/l), and substantial amounts of heavy metals (Fe, Cu, and Ni), and ammonium ions. A two-stage treatment was proposed. In the first stage most of the fluoride content was precipitated by the addition of lime to the solution. Calcium sulfate and heavy metal hydroxides were also precipitated. The fluoride content was decreased to 20 to 40 mg/l. In the second stage the residual fluoride was absorbed on a column of Al_2O_3, which showed a capacity of 4 to 7 mg of fluoride per gram of Al_2O_3 absorbent with a saturation capacity up to 14 mg/g of absorbent. The column effluent containing 2 to 3 mg of fluorine per liter could be discarded after dilution. The Al_2O_3 column was regenerated with a 1% aluminum sulfate solution, from which fluorine was precipitated by the addition of lime. The lime sludge was stored. (TTT)

47593 APPLICATIONS OF FLUIDISED BED IN ATOMIC ENERGY. Toor, F. D. (Atomic Energy Centre, Lahore). Nucleus (Lahore), 5: 70-4(July-Dec. 1968).

Advantages of a fluidized-bed system are discussed. Applications of the system for recovery of uranium from its ores, pro-

duction of UO_3, production of UF_6, production of UF_4, fuel reprocessing, radioactive waste processing, and heat transfer are considered. (M.C.G.)

47594 LIQUID–LIQUID EXTRACTION OF ALKALINE EARTH METALS. Mirza, M. Y. (PINSTECH, Nilore, Pakistan). Nucleus (Lahore), 5: 75–8(July–Dec. 1968).

It was concluded that the extractability of alkaline earth metals decreases from calcium to barium. This means that the improvement of mutual separation can be achieved by masking one element more effectively than the other. In the case of chelating agent, the stability constant decreases from calcium to strontium and the separation factor is low. The β-diketones seemed to be more promising than other reagents. The factors of economy, ease of preparation of reagent, extractability, and working efficiency can be balanced to obtain various useful separations. An investigation of the effects of different solvents, concentrations, aqueous media, composition of the extractable species formed, is recommended. (auth)

47595 THE CHROMATOGRAPHIC SEPARATION AND PURIFICATION OF CHEMICAL COMPOUNDS USED IN THE IONIZING RADIATION DETECTION TECHNOLOGY. Riedel, Jozef T. (Inst. of Nuclear Research, Warsaw). Przegl. Elektron., 9: 442–51 (Sept. 1968). (In Polish).

Results of work on the separation and purification of chemical compounds applied in radiation detector technology, using gas chromatography, are discussed. (auth)

47596 COLLECTION OF URANIUM IN SEA WATER. III. CONCENTRATION OF URANIUM IN DILUTE SOLUTIONS WITH SURFACE ACTIVE AGENTS. Ogata, Noboru; Kakihana, Hidetake (Tokyo Inst. of Tech.). Nippon Genshiryoku Gakkaishi, 11: 469–76(Aug. 1969). (In Japanese).

A study was made of foam separation with various kinds of surface active agents and adsorption separation with metallic soaps and lauryl amine salts, for the purpose of concentrating trace amounts of U in various kinds of salt solutions and seawater. The optimum conditions were influenced by the chemical components of the solutions. Foam separation of U was accomplished by using lauryl amine acetate on neutral solutions of various salts, alkyl benzyl ammonium chloride on weak alkali solution, and lauryl betaine on acidic solution of nitrate and seawater. U contained in seawater was adsorbed by Fe, Ti, and Zn soaps. In acidified seawater, U was adsorbed by Mg, Ti and Ni soaps. In chloride, sulfate and nitrate solutions U was adsorbed by Ca soap. U in seawater was adsorbed only when acidified. U was adsorbed from the various salt solutions by lauryl amine phosphate. (auth)

47597 TRAITEMENT DES COMBUSTIBLES IRRADIES. Compte Rendu du Ier Colloque Franco–Espagnol, Fontenay-aux-Roses, France, 11–14 Novembre 1967. (Processing of Irradiated Fuels. 1st Franco–Spanish Colloquium, Fontenay-aux-Roses, France, November 11–14, 1967). Fontenay-aux-Roses, France, Centre d'Etudes Nucleaires, [1968]. 224p. (In Spanish and French). (CONF-671143).

Sixteen papers presented at the conference are included; an abstract was prepared for each. (M.C.G.)

For abstracts of individual papers see: 47373, 47374, 47393, 47559, and 47598–47609.

47598 THE REPROCESSING OF MTR FUELS IN THE M-1 HOT LABORATORY. Lopez Perez, B.; Uriarte, A.; Ramos, L.; Folques, D. G. pp 5-10 of Traitement des Combustibles Irradies. Fontenay-aux-Roses, Centre d'Etudes Nucleaires, [1968]. (In Spanish).

From 1st Franco–Spanish Colloquium on the Processing of Irradiated Fuels, Fontenay-aux-Roses, France. See CONF-671143.

A general description is given of the reprocessing of irradiated fuels from the JEN-1 swimming pool reactor (MTR type ^{235}U 20%). This description includes the equipment of the cell and the chemical procedure employed. The experimental results concern the dissolution, filtration, first decontamination cycle, concentration, the second decontamination cycle, and the final purification of uranium and plutonium. (tr-auth)

47599 REPROCESSING OF NUCLEAR FUELS WITH A URANIUM–ALUMINUM ALLOY BASE. PLANS AND EXPERIMENTS. Michel, P. pp 11-22 of Traitement des Combustibles Irradies. Fontenay-aux-Roses, Centre d'Etudes Nucleaires, [1968]. (In French).

From 1st Franco–Spanish Colloquium on the Processing of Irradiated Fuels, Fontenay-aux-Roses, France. See CONF-671143.

In order to satisfy eventual needs for the reprocessing of irradiated fuels with a uranium–aluminum alloy base, a study program was established. It will make it easier to conduct the experiments that will be carried out in an active pilot plant and finally for the construction of a pilot plant for the reprocessing of irradiated fuels at Marcoule. The experimental process that will be carried out and the principal characteristics of the cell are described. The experiments already carried out, which are concerned with the dissolution phase of the process, are discussed. The experiments that will be undertaken next (extraction in pulse columns and continuous dissolution in a pilot scale plant are considered. (tr-auth)

47600 FLOW DIAGRAM FOR EXTRACTION FOR THE REPROCESSING OF MTR FUEL. Ramos Salvador, L.; Ortega, J.; Uriarte, A. (Junta de Energia Nuclear, Madrid). pp 23-33 of Traitement des Combustibles Irradies. Fontenay-aux-Roses, Centre d'Etudes Nucleaires, [1968]. (In Spanish).

From 1st Franco–Spanish Colloquium on the Processing of Irradiated Fuels, Fontenay-aux-Roses, France. See CONF-671143.

A resumé is presented of the laboratory studies and of the coefficient of decontamination studies obtained for the proposed chemical scheme. They include a first cycle for the decontamination of U and Pu, separation of Pu reextraction of U, and washing by the solvent. In this cycle, TBP is used (90%) dissolved in Shell Sol T. There is also a second cycle for the purification of U that consists of the extraction and the reextraction of U and the washing by the solvent. In the second cycle, TBP (15%) is used in the same diluent. (tr-auth)

47601 TREATMENT OF THE EFFLUENTS AT THE PLUTONIUM PRODUCTION CENTER AT MARCOULE. pp 35-41 of Traitement des Combustibles Irradies. Fontenay-aux-Roses, Centre d'Etudes Nucleaires, [1968]. (In French).

From 1st Franco–Spanish Colloquium on the Processing of Irradiated Fuels, Fontenay-aux-Roses, France. See CONF-671143.

The effluents from the Marcoule Center, with an activity between 10^{-4} and 10 μCi/ml, are separated into three categories, of which the two most active are treated by the chemical method. The long-lived fission products that they contain (Sr, Cs, Ce, Zr, Nb, and Ru) are coprecipitated or adsorbed to the extent of 80 to 90% for Ru and 99 to 100% for the other elements. The precipitates obtained (consisting of calcium carbonate, ferrous hydroxide, nickel ferrocyanide, lead periodate, and manganese dioxide) are covered by a continuous process with bitumen, which assures an excellent security in storage. The treated effluents are discharged into the Rhone. (tr-auth)

47602 TREATMENT OF RADIOACTIVE RESIDUES AT THE JUAN VIGON NATIONAL CENTER. De Lora, F.; Lopez Perez, B. (Junta de Energia Nuclear, Madrid). pp 43-52 of Traitement des Combustibles Irradies. Fontenay-aux-Roses, Centre d'Etudes Nucleaires, [1968]. (In Spanish).

From 1st Franco–Spanish Colloquium on the Processing of Irradiated Fuels, Fontenay-aux-Roses, France. See CONF-671143.

The inorganic radioactive liquid effluents produced at the Juan Vigon National Nuclear Energy Center can be decontaminated at the CIES pilot plant by ion exchange, evaporation, and solidification) before being stored underground. A description of the installations in the area of low activity is given, and the decontamination factors obtained are discussed. There is also a description of the treatment of the residues of medium activity as well as an exposition of the results obtained in the enclosing of these residues in bitumen. (tr-auth)

47603 DECONTAMINATION OF EFFLUENTS FROM PRODUCTION CENTERS BY THE STRONTIUM CARBONATE PROCESS. Pottier, P.; Chauvet, P. pp 53-69 of Traitement des Combustibles Irradies. Fontenay-aux-Roses, Centre d'Etudes Nucleaires, [1968]. (In French).

From 1st Franco–Spanish Colloquium on the Processing of Irradiated Fuels, Fontenay-aux-Roses, France. See CONF-671143.

The process actually used to obtain a satisfactory removal of strontium from radioactive effluents from the reprocessing of irradiated fuels consists of a precipitation of calcium carbonate at a pH of approximately 11. The principal inconvenience of the process is the production of large amounts of precipitate. (The concentration factor (FC = volume of effluent treated/volume of precipitate produced) obtained is approximately 25). A process was proposed and used industrially at the plant at The Hague, which makes it possible to attain a value for FC greater than 150. After elimination of the water hardness by precipitation using sodium carbonate at pH 11.5, strontium ions are added followed by calcium ions that coprecipitate with the radioactive strontium; flocculating agents of ferric iron plus polyelectrolytes make it possible to obtain a good precipitate formation. The decontamination factors for strontium and the total gamma and alpha emitters are equivalent. A limitation of this process is the presence of magnesium in appreciable quantities (50 to 100 mg/l) because it forms a large, light flocculant mass that settles very slowly. (tr-auth)

47604 RECOVERY OF SOME FISSION PRODUCTS. Raggenbass, A.; Lefevre, J. pp 71-81 of Traitement des Combustibles Irradies. Fontenay-aux-Roses, Centre d'Etudes Nucleaires, [1968]. (In French).

From 1st Franco-Spanish Colloquium on the Processing of Irradiated Fuels, Fontenay-aux-Roses, France. See CONF-671143.

Studies are in progress on processes for the separation of ^{137}Cs, ^{90}Sr, and ^{147}Pm. The ELAN pilot plant is being constructed and ought to make possible the separation of about 10^6 Ci of ^{137}Cs a year. The process, based on fixation on a mineral ion exchanger, is described. The process for the separation of ^{137}Cs from fission products from the treatment of uranium–molybdenum alloys is also described. The processes for separation of ^{90}Sr studied in the laboratory are based in part on the extraction by bis(2-ethylhexyl) phosphate, necessitating a neutralization of the solutions, and in part on the use of a mineral ion exchanger–antimonic acid, which is sufficiently selective to make it unnecessary to change the initial acid solution. The recovery of ^{147}Pm was the object of preliminary studies on the separation of groups of rare earths. (tr-auth)

47605 PRESENT-DAY PROGRAM AND FUTURE DEVELOPMENT OF THE PLUTONIUM CHEMISTRY GROUP OF THE OFFICE OF CHEMISTRY AND ISOTOPES. Ruiz Sanchez, F. (Junta de Energia Nuclear, Madrid). pp 143-6 of Traitement des Combustibles Irradies. Fontenay-aux-Roses, Centre d'Etudes Nucleaires, [1968]. (In Spanish).

From 1st Franco-Spanish Colloquium on the Processing of Irradiated Fuels, Fontenay-aux-Roses, France. See CONF-671143.

In relation to the other departments of the JEN, this group deals chiefly with the study and the analytical control of the products obtained in the course of and at the end of the reprocessing of irradiated nuclear fuels coming from the JEN-1 reactor and the M-1 hot cell. Studies of the characteristics of the products are carried out with the aid of isotopic analysis of the alpha emitters (in particular uranium and plutonium) and the determination of the degree of burnup by the ratio $^{236}U/^{238}U$. The concentrations of the solutions to be treated are in the neighborhood of 200 to 300 g U/l and less than 30 g Pu/l. For power reactors provision is made for the study of the gamma radiometry of ^{137}Cs. Likewise, the physicochemical phenomena that plutonium undergoes (autoradiolysis, dismutation, changing of valence, formation of complexes, etc.) will be studied. In addition, the separation of uranium from plutonium by liquid–liquid extraction of nitric acid solutions at high plutonium concentrations (~50 g Pu/l) will be studied. Because of the special conditions of the extraction process, it will be necessary to pay particular attention to the radiolytic degradation of the extraction agents and the solvents. A critical study of the utilization of those that will be the most appropriate is planned. (tr-auth)

47606 INDUSTRIAL REPROCESSING OF IRRADIATED URANIUM–MOLYBDENUM FUELS. Plessy, L.; Travert, J. pp 147-60 of Traitement des Combustibles Irradies. Fontenay-aux-Roses, Centre d'Etudes Nucleaires, [1968]. (In French).

From 1st Franco-Spanish Colloquium on the Processing of Irradiated Fuels, Fontenay-aux-Roses, France. See CONF-671143.

The introduction of molybdenum into uranium to improve the mechanical properties and the behavior on thermal cycling made necessary the modification of certain conditions in the reprocessing of irradiated fuels. In dissolution, because of the limited solubility of Mo in acid, its concentration should not exceed 150 g/l in U for the alloy of 1.1% and 300 g/l for the alloy of 0.5%, the acidity being 3N. In this manner, no precipitate is apparent during the dissolution of the uranium. The presence of Mo makes the alloy more readily soluble than the pure U in the acid. In the first extraction cycle it makes possible better decontamination from Ru. The presence of Mo does not lead to any complications in Zr extraction. For concentration of the fission products the process with destruction of the nitric acid by formaldehyde is used. The Mo present in the extraction effluents is kept in solution by the addition of orthophosphoric acid. These studies and experience in this area have led to maintaining the acidity at about 1.5 N during the concentration and to decrease it a little to about 1.0 N at the end of the cycle. In this manner, the stored solutions ought to be stable. (tr-auth)

47607 FLOW DIAGRAM FOR THE REPROCESSING OF IRRADIATED URANIUM–MOLYBDENUM FUELS. FIRST DECONTAMINATION CYCLE. Akhtar Zaidi, Hasseb; Abellan, Ortega (Janta de Energia Nuclear, Madrid). pp 161-80 of Traitement des Combustibles Irradies. Fontenay-aux-Roses, Centre d'Etudes Nucleaires, [1968]. (In Spanish).

From 1st Franco-Spanish Colloquium on the Processing of Irradiated Fuels, Fontenay-aux-Roses, France. See CONF-671143.

A chemical scheme was established for fuel elements consisting of a uranium–molybdenum alloy (Mo content of 1%). A laboratory-scale study was made of the first decontamination cycle characterized by: 1) use of TBP (18.5%) in Shell-Sol T; 2) uranium and plutonium remain together during the entire first cycle with the separation being made during the second decontamination cycle; and 3) concentration of the uranium in the aqueous phase to 60 g/l on reextraction. (tr-auth)

47608 USE OF TERTIARY AMINES IN THE CHEMICAL REPROCESSING OF IRRADIATED FUELS. Bathellier, A. pp 181-200 of Traitement des Combustibles Irradies. Fontenay-aux-Roses, Centre d'Etudes Nucleaires, [1968]. (In French).

From 1st Franco-Spanish Colloquium on the Processing of Irradiated Fuels, Fontenay-aux-Roses, France. See CONF-671143.

Long-chain tertiary amines makes possible the selective extraction and separation of quadrivalent actinides, such as Th, U, Np, and Pu, in nitric acid medium. They can be used in the final cycle of the chemical reprocessing of irradiated fuels. The current state of development of the applications of these amines and the difficulties encountered are presented. (tr-auth)

47609 SEPARATION OF URANIUM, PLUTONIUM, AND FISSION PRODUCTS BY SYNTHETIC INORGANIC ION EXCHANGERS. Rodriguez Parra, M.; Uriarte Hueda, A.; Lopez Perez, B. pp 201-20 of Traitement des Combustibles Irradies. Fontenay-aux-Roses, Centre d'Etudes Nucleaires, [1968]. (In Spanish).

From 1st Franco-Spanish Colloquium on the Processing of Irradiated Fuels, Fontenay-aux-Roses, France. See CONF-671143.

Various experiments were carried out with the cations H^+, UO_2^{2+}, Cs^+, Pu^{4+}, Sr^{2+}, Ce^{3+}, Zr–Nb, Ru, and Al^{3+} using silica gel and unfired Vycor glass as ion exchangers. The separation coefficients between the nitric acid solutions and the silica gel or unfired Vycor glass were determined as a function of certain variables: time of agitation, temperature, concentration of nitric acid, and concentration of ion in the aqueous phase. Finally, experiments were carried out in columns, either with solutions of pure cations or with mixtures of several of these same cations, which have made it possible to arrive at satisfactory results and which concern the separation and purification of the solutions resulting from the reprocessing of irradiated fuels. (tr-auth)

47610 CHROMATOGRAPHY OF THYMINE RADIOLYSIS PRODUCTS. Teoule, R.; Cadet, J. (CEN, Grenoble, France). J. Chromatogr., 43: 368-75(Sept. 9, 1969). (In French).

Carbon-14-labeled thymine in aqueous solution (10^{-3} to 10^{-4} M) was irradiated with γ rays of ^{60}Co at doses between 10^2 and 10^6 rad. Different chromatographic techniques for separation of the radiolysis products are described. Solvent systems such as butanol–water (86:14) and acetonitrile–phosphate buffer (0.2M NaH_2PO_4 and 0.2M Na_2HPO_4) (85:15) were employed. Bidimensional thin-layer chromatography with cellulose powder was also used. For this experiment the best solvents were either butanol–methanol–water–NH_4OH (60:20:20:1) or propanol–water (10:3) in the first dimension, and isopropanol–water-saturated $(NH_4)_2SO_4$–I M K_2HPO_4 (3:77:20) in the second dimension. The separation is rapid and can be performed at 4°. A new photoproduct of thymine, 5-methyl-5-hydroxy hydantoin was identified. R_F values of this compound are given. (auth)

47611 SEPARATION OF ^{99}Mo AND ^{99m}Tc. Kulesza, Albin (Inst. of Nuclear Studies, Swierk, Poland). Nukleonika, 14: 261-7 (1969). (In Polish).

The separation of ^{99}Mo from a solution of uranium fission products, and the separation of ^{99m}Tc from ^{99}Mo are described. (auth)

47612 SEPARATION OF EUROPIUM FROM IRRADIATED UO_2–Mg FUEL SAMPLES FOR BURN-UP DETERMINATION. Smulek, Wiktor (Inst. of Nuclear Research, Warsaw). Nukleonika, 14: 521-36(1969).

A three-step procedure for the separation of europium from irradiated UO_2–Mg fuel samples by means of reversed-phase partition chromatography was developed. As the stationary phase bis(2-ethylhexyl)ortho-phosphate adsorbed on siliconated kieselguhr was used, and the elution was carried out with nitric acid of varying concentrations. The separated europium was not contaminated by other fission products and could be used for measuring the ratio of radioactivity of ^{154}Eu to ^{155}Eu, which may serve as a nuclear fuel burnup monitor. The behaviour of some fission products that may disturb either the separation or the measurement of europium was examined under the separation conditions established for europium. (auth)

47613 EVALUATION OF USEFULNESS OF INDIGENOUS ION EXCHANGE RESINS FOR REMOVAL OF STRONTIUM FROM MILK. I. CHARACTERISTICS OF THE ION EXCHANGERS AND REMOVAL OF $^{85+89}Sr$ FROM MILK. Kornacki, Kazimierz;

Poznanski, Stefan; Jedrychowski, Lucjan. Nukleonika, 14: 397-406(1969). (In Polish).

Five indigenous ion-exchange resins were investigated as to their usefulness for removal of radioactive strontium from milk. In comparison with the standard cation exchanger Amberlite IR-120, the cation exchangers SD and FPC proved to be the most useful for removing radionuclides from milk. Very discouraging results were obtained with the cation exchanger MK-2, particularly with the MK-3. As the pH of milk was decreased, the degree of removal of radioactive strontium increased with all the ion-exchange resins investigated. (auth)

47614 REMOVAL OF ^{90}Sr AND ^{137}Cs BY PRECIPITATE FLOTATION. Ogiaza, Jan; Siemaszko, Aleksander (Inst. of Nuclear Studies, Warsaw). Nukleonika, 14: 275-81(1969). (In Polish).

The effectiveness of removal of ^{90}Sr and ^{137}Cs by precipitate flotation was studied. Five different surface-active agents were examined. It was found that the efficiency of removal of these elements by this method was a dozen times higher compared with ion flotation. (auth)

47615 NEW LIQUID–LIQUID EXTRACTION METHOD FOR THE SEPARATION OF CERIUM(IV) FROM BERKELIUM(IV) AND OTHER ELEMENTS. Moore, Fletcher L. (Oak Ridge National Lab., Tenn.). Anal. Chem., 41: 1658-61(Oct. 1969).

A method for the separation of Ce(IV) from Be(IV) based on the efficient extraction of Ce(IV) from dilute nitric acid solutions containing bromate ions with a quaternary ammonium nitrate, Aliquat 336-S–NO_3–xylene, is presented. Berklium(VI) shows very low extractability in this system. The marked difference is extractability of Ce(IV) and Be(IV) from nitric acid solutions is optimum in the 2M nitric acid region. A study of the extraction behavior of other elements showed that alkalies, alkaline earths, trivalent lanthanide and actinide elements, iron, zirconium, and niobium showed negligible extractability. UO_2^{2+}, NpO_2^{2+}, and PuO_2^{2+} ions showed high solubility in the organic phase, 80, 99, and 96%, respectively. (D.H.M.)

47616 SOLVENT EXTRACTION OF RUTHENIUM FROM AQUEOUS HYDROCHLORIC AND HYDROBROMIC ACID SOLUTIONS. II. Meier, H.; Boesche, D.; Zimmerhackl, E.; Albrecht, W.; Hecker, W.; Menge, P.; Ruckdeschel, A.; Unger, E.; Zeitler, G. (Staatlichen Forschungsinstitut fuer Geochemie, Bamberg, Ger.). Mikrochim. Acta, No. 5, 1107-13(1969). (In German).

The chloro- and bromo-complexes of trivalent ruthenium can be extracted from solutions containing HCl and HBr less well than the corresponding osmium complexes. The extraction agents are graded in their action as follows: amines (DBA) > organophosphorus compounds (TBP, TOPO, etc.) > alcohols > ketones. Whereas there is a mechanism in the cases of the organophosphorus compounds, alcohols, and ketones, as is also characteristic of the osmium extraction, the amines exhibit deviations from the corresponding osmium extraction. Confirmations or guide lines with respect to the procedures underlying the extraction of the acido complexes can be obtained by a consideration of the agreement with or deviations from the extraction mechanisms of the ruthenium and osmium extractions. In addition, the extraction capability, which is absent in some extractants, can be employed when working out extraction procedures, for example, for the osmium/ruthenium separation. (auth)

47617 THIN-LAYER CHROMATOGRAPHY OF INORGANIC IONS. V. Lesigang-Buchtela, Margrit (Univ., Vienna). Mikrochim. Acta, No. 5, 1027-32(1969). (In German).

Thin-layer chromatographic separations were carried out on layers consisting of silica gel mixed with ammonium phosphododecamolybdate or zinc cyanoferrate(II) and cobalt cyanoferrate(II). Ammonium phosphododecamolybdate and zinc cyanoferrate(II) are suitable for alkali metal ions, while ammonium phosphododecamolybdate and cobalt cyanoferrate(II) are suitable for di- and trivalent elements. A separation was conducted of the mother-daughter system strontium-90/yttrium-90 and separations with model substances were described for the systems barium-140/lanthanum-140, barium-131/cesium-131, and cesium-137/barium-137. (auth)

47618 EXTRACTION OF PENTAVALENT PROTACTINIUM, TANTALUM, AND NIOBIUM BY TRIBUTYL PHOSPHATE BEGINNING WITH HYDROFLUORIC ACID–PERCHLORIC ACID MEDIA. Bonnet, M.; Guillaumont, R. (Institut de Physique Nucleaire, Arcueil, France). Radiochim. Acta, 12: 98-107 (Aug. 1969). (In French).

The behavior of pentavalent protactinium, tantalum, and niobium in the system: $HClO_4$, $NaClO_4$, HF-(μ = 3)-benzene, tributylphosphate (TBP) – have been investigated as a function of hydrogen and fluoride ion concentration, respectively, in the aqueous phase as well as a function of the TBP concentration in the organic phase. Absorption spectra for Pa(V) and Nb(V) in $HClO_4$ 3M–HF solutions have also been measured. All out results are in agreement with the presence of $HPaF_7$- and a hexafluoro species in fluoroperchloric medium μ = 3, $1 < [H^+] < 3$ N, 10^{-6}, $< [F^-] < 10^{-3}$ N. They are both extracted into the organic phase as $HPaF_6 \cdot 2TBP$. The extractability of Pa(V) decreases as the aqueous [HF] concentration increases while the reverse is true for Ta(V) and Nb(V) ([HF]) $\lesssim$ 0,4M). This effect is caused by the different complexation of Pa(V), Ta(V), and Nb(V) at the same fluoride ion concentration. The distribution of Ta(V) and Nb(V) in the system under investigation is discussed. (auth)

47619 STUDY OF MULTI-LOADED METAL SALT–ION EXCHANGE RESINS. I. MULTI-LOADED NICKEL FERROCYANIDE-ANION EXCHANGE RESIN AND NICKEL FERROCYANIDE–CALCIUM PHOSPHATE–ANION EXCHANGE RESIN. Watari, Kazuo; Imai, Kiyoko; Izawa, Masami (National Inst. of Radiological Sciences, Chiba, Japan). J. Nucl. Sci. Technol. (Tokyo), 6: 522-5(Sept. 1969).

The preparation of a number of metal salt-ion exchange resins and their application to radiochemical separation are discussed. The resins prepared by the subject method have both metal salt and ion exchange resin properties. Discussion is given on the preparation and application of multi-loaded metal salt-ion exchange resins which contain one or more kinds of insoluble metal salt in an ion exchange resin, for which the residual ion exchange ability of an intermediate metal salt-ion exchange resin is utilized. The properties of multi-loaded nickel ferrocyanide-anion exchange resins and nickel ferrocyanide–calcium phosphate-anion exchange resins are also discussed. (auth)

47620 ENRICHMENT OF STABLE ISOTOPES. IV. THEORETICAL TREATMENT OF ION-EXCHANGE SYSTEMS USED FOR LITHIUM ISOTOPE SEPARATION. Hagiwara, Zenzi (Tohoku Univ., Sendai). J. Nucl. Sci. Technol. (Tokyo), 6: 508-13(Sept. 1969).

In order to gain an insight into exchange systems used for Li isotope separation, experiments have been made from the point of rate theory. From the resulting data were derived equations related to the plate height due either to particle or to film diffusion. Using these equations, the plate height values based on particle and on film diffusion were determined by curve fitting. Further, ion exchange reactions at the front and tail boundaries of the Li adsorption band were investigated in detail. Finally, the validity of the equations derived was proved by good agreement found with the experimental data obtained on an Li elution system under steady state. (auth)

47621 ELECTROLYTIC SEPARATION OF RHENIUM AND MOLYBDENUM FROM THEIR DISULFIDES. Simson, T. F.; Rozhdestvenskaya, Z. B.; Songina, O. A.; Koval, A. V. (Kazakh State Univ., Alma-Ata, USSR). Zh. Anal. Khim., 24: 1352-6 (Sept. 1969). (In Russian).

During the dissolution of rhenium and molybdenum disulfides in the presence of electrically generated oxidants (chlorine, oxygen, etc.) the extraction of rhenium and molybdenum depends on the electrolyte composition, current density, and time of electrolysis. The complete extraction of milligram amounts of rhenium in the presence of 1000-times its amount of molybdenum can be achieved in 1 hour under the following conditions: a 5% solution of ammonium chloride acidified by hydrochloric acid to pH 2.5 used as electrolyte, the current density of 100 mA/cm^2. Under the same conditions 70 to 80% molybdenum can be extracted; molybdenum precipitates on the cathode; rhenium remains in the solution. (auth)

47622 SOLVENT EXTRACTION OF ZIRCONIUM WITH AMIDES OF PHOSPHOORGANIC ACIDS FROM HYDROCHLORIC ACID SOLUTIONS. Alimarin, I. P.; Fadeeva, V. I.; Nifant'ev, E. E.; Litvisheva, A. S. (Moscow State Univ.). Zh. Anal. Khim., 24: 1386-9(Sept. 1969). (In Russian).

A study has been made of the solvent extraction of zirconium from hydrochloric acid solutions by means of benzene solutions of diethyl amides of certain alkyl phosphoric acids. The composition of the complexes corresponds to the formula $ZrCl_4 \cdot 2R$. Zirconium can be determined in the presence of 100 times its amount of Th, Sc, Fe, La, and rare earths after its extraction with a benzene solution of tetraethyldiamide of hexylphosphoric acid (hexyl ester of tetraethylphosphorodiamidic acid). (auth)

EARTH SCIENCES

Geology and Hydrology

Refer also to abstracts 47641, 47666, 47667, 47866, 47867, and 48065.

47623 (EUR–4294) SIMULATION OF ^{90}Sr TRANSPORT THROUGH SOILS: EVALUATION OF PARAMETERS. Frissel, M. J.; Poelstra, P.; Reiniger, P. (Instituut voor Toepassing van Atoomenergie in de Landbouw, Wageningen (Netherlands)). June 18, 1969. 63p. Dep. CFSTI (U. S. Sales Only).

A model simulating the migration of ^{90}Sr in agricultural soils is presented. The alternatives considered are plowing or no plowing; continuous contamination or contamination occurring once only. Furthermore, many soil and climatic parameters of importance for the transport are also considered. Calculations on 72 combinations of parameters were performed. To make possible a general application of the results two coefficients were used: the ^{90}Sr leaching indicator and the mean apparent diffusion coefficient. Both coefficients can be calculated from soil and climatic characteristics. The results are presented in the form of 4 schemes and 42 figures. (auth)

47624 (PNE–953) PRESHOT GEOPHYSICAL STUDIES OF CABRIOLET NUCLEAR CRATER SITE. Ramspott, L. D. (California Univ., Livermore. Lawrence Radiation Lab.); Stearns, R. T.; Meyer, G. L. (California Univ., Mercury, Nev. Lawrence Radiation Lab.). Apr. 1968. 24p. (UCRL–50458). Dep. CFSTI.

The Cabriolet Project was a Plowshare Program nuclear cratering experiment performed for the purpose of obtaining basic data on cratering phenomena and distribution of radioactivity. The 2.5 kt device was buried 52 m deep in hard, dry porphyritic trachyte located in the Nevada Test Site. Seven holes were drilled at the site. Three were used for density logs, caliper logs, uphole seismic surveys, and three-dimensional survey logs. Below 43 m the rock was found to be dense (2.40 to 2.54 g/cm^3) and relatively unfractured. The caliper logs showed zones of extreme caving in all holes—particularly in the less dense or upper portions. The uphole seismic velocity measurements showed increasing velocity with increasing depth in the order of 700 mps at 0 to 10 m depth; 1100 mps at 10 to 35 mps; and 4000 mps at 35 to 60 m depth. The three-dimensional velocity logs were invalid due to inability of the test holes to contain fluid. The most important causes of variation in velocity and density were concluded to be vesicularity, degree of weathering, and degree of fracturing of the rocks. The wide variations of these parameters overshadow the other relatively minor variations of the rocks at this site. (L.C.L.)

47625 (UCRL–Trans–10362) INTERPRETATION OF GGL CEMENTOGRAMS FOR WELLS IN THE WESTERN PREDKAVKAZ'E. Popov, V. K.; Nazarenko, L. I.; Omes, S. P. Translated for Univ. of California, Lawrence Radiation Lab., Livermore, from Razved. Geofiz., 23: 94–105(1967). 22p. Dep. CFSTI.

The use of γ-γ logging to control the cementation of concrete casing columns in deep wells was evaluated on the basis of data from over 400 casing operations. Gamma-gamma logging (GGL) for cementation control is based on the fact that the scattered γ-ray intensity depends on the density of the medium. Since solid concrete is denser than the well drilling solution, it is possible to determine where cementation has occured, and therefore to control the construction of the casing columns. The GGL cementometer consists of a γ source and circular array of γ detectors which record scattered γ radiation at angular intervals of 90 and 120°, respectively. The effects of many variables on the GGL data obtained were investigated and include concrete density, casing thickness, well diameter, density of surrounding rock material, and eccentricity of casing column. It was concluded that if the density of the concrete casing exceeds that of the drilling solution by a critical value then γ-γ logging can successfully be used to determine the height, eccentricity, and thickness of concrete casings in wells. (L.C.L.)

47626 (USGS–474–6) SOME PHYSICAL PROPERTIES OF ROCKS IN DRILL HOLE UAe–3, AMCHITKA ISLAND, ALASKA. Amchitka 8–2. Lee, William H. (Geological Survey, Denver, Colo.). Apr. 1969. 12p. Dep. CFSTI.

Physical properties of rocks from drill hole UAe–3 were analyzed by averaging and minimum-maximum ranging of data derived from Birdwell 3-D log computations. USGS laboratory determinations of physical properties are presented in table form. Rocks in the drill hole were divided into 12 lithologic types for purposes of analysis. The physical property data of similar lithologic types were compared and physical property trends were established that indicated age and depth of burial have some influence on the individual physical properties. (auth)

47627 (USGS–474–18) REPORT OF EXPLORATION PROGRESS, CENTRAL NEVADA, PERIOD JANUARY 1, 1968–APRIL 1, 1969. Central Nevada–30. (Geological Survey, Denver, Colo.). Apr. 1969. Contract AT(29–2)–474. 35p. Dep. CFSTI.

Geological explorations in Central Nevada were continued during January 1968 to April 1969. The results are presented as tabulated data which identify the location and depth of each drill hole, the type of rock found in each drill hole, and the depth location of each distinct rock stratum in each hole. (L.C.L.)

47628 (USGS–474–40) RECORDS OF SELECTED WELLS AND SPRINGS IN THE RULISON PROJECT AREA, GARFIELD AND MESA COUNTIES, COLORADO. Hurr, R. Theodore; Wilson, Woodrow W.; Welder, Frank A.; Emerson, R. L. (Geological Survey, Denver, Colo.). Sept. 1969. 17p. (PNE–R–6). Dep. CFSTI.

An inventory of wells and springs in the Rulison Project area and vicinity was made from March 20 to April 3 and from May 20 to 25, 1969, for the purpose of documenting the physical conditions of the wells and springs, and to collect samples of water prior to the nuclear event. The inventory was limited to a circular area within a 20 km radius of the emplacement hole. The results of the inventory are presented in tabulated form. (L.C.L.)

47629 OCCURRENCE OF ^{90}Sr IN THE ZEGRZYNSKI LAKE IN THE YEARS 1963–1964. Dojlido, Jan (Inst. of Hydrology, Warsaw). Nukleonika, 14: 213–20(1969). (In Polish).

The results of studies on the occurrence of ^{90}Sr in the Zegrzyński artificial lake in 1963 and 1964 are presented. The ^{90}Sr concentrations found were as follows: the water 0.9 to 3.8 pCi/l, bottom sediment 0.1 to 2.5 pCi/g ash, plants 0.4 to 9.9 pCi/g ash, periphyton 0.3 to 4.0 pCi/g ash, and fish 0.5 to 4.0 pCi/g ash. The average ^{90}Sr concentration in water was found to decrease from 2.6 pCi/l in 1963 to 2.0 pCi/l in 1964. The strontium activity of water in strontium units ranged from 12 to 100 (35.8 on the average). It was found that among the live organisms studied, fish showed the most pronounced ^{90}Sr discriminating properties. (auth)

47630 METHOD OF ABSOLUTE DATING OF THE COASTAL MARINE SEDIMENTS BY MEANS OF THE VERTICAL DISTRIBUTION OF THE FALLOUT RADIONUCLIDES. Schreiber, Bruno (Univ. of Parma, Italy). Atti. Accad. Naz. Lincei, Rend., Cl. Sci. Fis., Mat. Natur., 45: 515–21(Dec. 1968).

Studies were made on the vertical distribution of gross beta radioactivity in cores collected from the continental shelf of the Ligurian and North Adriatic Seas. The gross beta radioactivity in the coastal marine sediment was relative to the fallout from nuclear tests and coeval sedimentation of clays. Graphic comparisons were made between known beta fallout values in some areas and core sampling beta values from the marine coastal areas in Italy. (J.C.W.)

47631 WATER CONTENT MEASUREMENT WITH 60 keV GAMMA RAY ATTENUATION. Groenevelt, P. H. (State Agricultural Univ., Wageningen, Netherlands); de Swart, J. G.; Cisler, J. Bull. Int. Ass. Sci. Hydrol., 14: No. 2, 67–78(1969).

A study of the use of americium-241 for measuring the water content of soil samples by attenuation of low energy gamma rays is reported. One of the advantages is that the optimum thickness of the soil sample is about 4 to 5 cm. However, one of the difficulties encountered is related to the determination of the absorption coefficient, which is generally lower than the theoretical value. The problems of counting losses in the gamma spectrometer system are discussed. Experimental results are presented showing the importance of the system geometry. (auth)

47632 RADIOACTIVITY AND IONIC AGE OF YOUNG EFFUSIVES OF SYRIA. Cherdyntsev, V. V.; Senina, N. I. (Inst. of Geology, Moscow). Geokhimiya, No. 8, 1022–3(Aug. 1969). (In Russian).

Tabulated data are given on the content and ratio of uranium and thorium isotopes (^{238}U, ^{234}U, ^{232}Th, ^{230}Th, and ^{228}Th) in five types of basalts in Syria. (R.V.J.)

47633 THE EFFECT OF MEASUREMENT ERRORS ON THE RESULTS OF A DIFFERENTIAL INTERPRETATION OF GAMMA-WELL-LOGGING. Volodin, K. I.; Roshchin, Yu. V. At. Energ. (USSR), 27: 152–4(Aug. 1969). (In Russian).

The effects of random errors in the initial gamma scan of a borehole on the results of a differential interpretation of the individual layers were investigated by an algorithm close to that described by Scott in Geophysics, 28, 3(1963). One difference was that after each iteration, negative values (caused by errors in the initial data) were replaced by zeros, and the remaining values were normalized with respect to the initial value. The study was carried out by means of modeling with the help of a computer. Models of ore intrusions with a varying rate of change in the content of radioactive elements in the strata were used in the modeling studies. The results of measuring the intensity of gamma emission were followed at different levels of random errors. The results of interpreting gamma ray intensity curves obtained with given errors were compared with true contents in separate strata, from which a nondistorted intensity curve was calculated. The effects of errors in the initial gamma log on the results of estimating contents in separate strata, and also on the results of estimating the static distribution function of the true contents along the ore intrusion as a whole were taken into consideration. It was found that the level of random errors in the interpretation results significantly exceed the level of random errors in the initial gamma log curve. On increasing the number of iterations, the variation coefficient tended to approach that of the true content. (TTT)

47634 DETERMINATION OF THE TOTAL BETA ACTIVITY OF WASTES AND FRESH WATERS. Berke, Barnabas; Gyoenyoer, Bela; Viragh, Elemer. Magy. Kem. Lapja, 24: 361-5(July 1969). (In Hungarian).

The determination of the beta activity of diverse waters forms an important part of environmental radioactivity monitoring. The laboratory methods of indirect checking are discussed. Detailed attention is devoted to concentration and precipitation methods, including the problem of concentration efficiency. The lowest level of detectable activity is considered. A detailed description is given of the equipment constructed for detecting low activity levels, as well as of the calibration tests. (auth)

47635 ISOTOPIC COMPARISON OF LEAD IN TEKTITES WITH LEAD IN EARTH MATERIALS. Wampler, J. M.; Smith, D. H.; Cameron, A. E. (Oak Ridge National Lab., Tenn.). Geochim. Cosmochim. Acta, 33: 1045-55(Sept. 1969).

Lead samples from moldavites and from Ries glass are isotopically similar, except that the Ries glass tends to be slightly enriched in the radiogenic lead isotopes relative to moldavites. The lead in these materials is similar to the lead found in oceanic sediments and falls on the growth curves typical of most terrestrial rock and ore lead samples. This is true of lead in other tektite groups, with one exception. Lead from Ivory Coast tektites does not fall on the growth trend of modern terrestrial lead. Lead samples from Bosumtwi Crater dark glass and from the gray phyllite (country rock) at Bosumtwi Crater are similarly displaced from the typical growth trend. These features may be explained in terms of lead isotopic development over long periods of time in environments which differ somewhat from the normal in terms of relative U, Th, and Pb abundances, which suggests that the tektites as well as the impact glass were derived from the Precambrian rocks at Bosumtwi Crater. High U/Pb ratios ($^{238}U/^{204}Pb > 20$) were found in all tektites analysed, indicating enrichment of U relative to Pb either at the time of tektite formation or within a time period not exceeding a few hundred million years prior to tektite formation. Lower U/Pb ratios were found in the impact glasses. Lead samples from a bediasite and a Georgia tektite are the same, isotopically, and similar to lead from other tektite groups (except the Ivory Coast tektites). (UK) (auth)

47636 NEW FISSION TRACK AGES OF TEKTITES AND RELATED GLASSES. Gentner, W.; Storzer, D.; Wagner, G. A. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Geochim. Cosmochim. Acta, 33: 1075-81(Sept. 1969).

Fission track dating was applied to a large number of australites, Muong Nong type tektites, Darwin glasses, and Libyan Desert glasses. It was found that these glasses often have lowered fission track ages due to annealing effects. The same specimens also have smaller fission track etch pits. According to the diminishing percentage of etched fossil fission track diameters, lowered fission track ages are corrected. A mean age of 0.7 M yr was found for eleven australites, six Darwin glasses and seven Muong Nong type tektites (from Laos and Thailand), indicating a related genesis of these glasses. Uncorrected fission track ages of five Libyan Desert glasses ($26.6^{+1.1}_{-1.3}$ M yr) and two bediasites ($33.2^{+1.3}_{-1.5}$ M yr) were found to be different. An interrelationship between these two groups of glasses seems to be improbable from the results. (auth) (UK)

47637 ABOUT THE DIFFUSION LOSS OF LEAD BY A RADIOACTIVE MINERAL. Shestakov, G. I. (Geological Inst., Kola , USSR). Geokhimiya, No. 9, 1103-11(Sept. 1969). (In Russian).

Experiments were carried out on the sublimation of lead from monazite and zircon at 800 to 1100°C in a nitrogen flow in the presence of carbon and without it. It was found that the rate of the sublimation process is determined by the diffusive lead flow to the surface of the mineral. However, this is true only under conditions of a constant lead removal from the surface without substantial expenditures of thermal energy (sublimation of lead reduced by carbon). In the absence of a reducer the lead atoms have to get over a high potential barrier of the chemical bond of lead with the material of the surface in order to give rise to the concentration gradient on the surface of the mineral. Under natural conditions diffusion losses of lead may occur if the barrier height is lowered as a result of a contact with rock-forming minerals with a lesser chemical potential of lead. (auth)

47638 THE RADIOACTIVITY OF THE IVORY COAST TEKTITES AND THE FORMATION OF THE BOSUMTWI CRATER (GHANA). Rybach, L. (Inst. for Crystallography and Petrography, Zurich); Adams, J. A. S. Geochim. Cosmochim. Acta, 33: 1101-2(Sept. 1969).

Further evidence for the impact origin of the Ivory Coast tektites and the Bosumtwi Crater is presented; uranium, thorium, and potassium abundances showed very similar patterns in tektites and crater rocks. (auth)

47639 NEED FOR ADVANCE PLANNING OF THERMAL DISCHARGES. Jaske, R. T. (Battelle Memorial Inst., Richland, Wash.). Nucl. News, 12: No. 9, 65-70(Sept. 1969).

Factors affecting siting of nuclear power plants are thermal modification, plant size, environmental impact, and consumer requirements. A study of the impact of thermal discharges on utility industry planning is discussed. Factors to be taken into consideration include physical area of plants, cooling waters affected and interaction of ecologic processes by the thermal pollution, prediction of the dispersion of the effluent plumes, storage and waste disposal, and seasonal temperature variations which could enhance winter transportation on formerly icy waters. Economics of proposed plants is discussed. (J.C.W.)

47640 THERMAL POLLUTION AS FACTOR IN POWER PLANT SITE SELECTION. Morgan, Paul V. (Cyrus Wm. Rice and Co., Pittsburgh); Bramer, Henry C. Nucl. News, 12: No. 9, 70-4(Sept. 1969).

Standards have been set for use of interstate streams and coastal waters by the nuclear industry. Power plant site selections should be made in order that existing water quality standards are not violated. Criteria from the National Technical Advisory Committee are discussed. Studies recommended for site selection include biological, chemical, and physical measurements, as well as mathematical and physical models. The adequacy of the designed thermal pollution abatement measures and projected operating procedures are surveyed. Seasonal variations, long-term flow variations, and projected stream utilization are also involved in the economic aspects for siting power plants. (J.C.W.)

Meteorology

Refer also to abstract 47664.

47641 (AD-690189) CLOUD CHEMISTRY OF FALLOUT FORMATION. Final Report. Norman, John H.; Winchell, Perrin; Staley, Harry G. (Gulf General Atomic, Inc., San Diego, Calif.). Jan. 31, 1969. Contract N00228-68-C-2376. 63p. (GA-9180). CFSTI.

Studies of fission-product gamma emanation shortly after fission (1 to 100 sec) were initiated. The half-lives that will be established in this program, when used in conjunction with initial yields, will provide the fission-product yield history for calculational models. The studies undertaken include: an investigation of the transitive behavior of fission products from approximately 1 sec after fission, experiments to establish recoil range as a parameter to use for identifying the sources of specific gamma rays, and design of a steady-state tape system for catching and subsequently investigating recoil fission products. Studies of diffusion of various nuclides in the $CaO-Al_2O_3-SiO_2$ system, the $Na_2O-Al_2O_3-SiO_2$ system and Small Boy soil from the Nevada test site were made. A mathematical description of sorption of gaseous components by a particle, using condensation coefficients and condensed-state diffusion coefficients, is presented. This treatment suggests that condensation coefficients become im-

portant of the process only when they are lower than approximately 2×10 to the -6th power. (auth) (USGRDR)

47642 (FFR-406/69) MEASUREMENTS OF FISSION PRODUCT ACTIVITY IN AIR AND IN PRECIPITATION UP TO 31 DECEMBER 1968. Report No. 30. (Forsvarets Forskningsrad, Copenhagen (Denmark)). May 1969. 12p. (In English and Danish). Dep. CFSTI (U. S. Sales Only).

The latest results from measurements of gross beta activity and cesium-137 in air at ground level and in precipitation at various locations in Denmark proper, the Faroes, and Greenland are given. Further, results of measurements of beryllium-7, zirconium/niobium-95, and strontium-90 are also reported. (Denmark)

47643 (NSJ-tr-148) DEPOSITION OF RADIOACTIVE FALLOUT IN NIIGATA CITY, JAPAN. REPORT I. RADIOACTIVE CONTAMINATION OF RAIN, SNOW, AND ATMOSPHERIC DUST OBSERVED FROM 1960 TO 1962. Sugai, Ryuichi; Takizawa, Yukio; Kosaka, Takao. Translated from Niigata Igakkai Zasshi, 81: 589-93(Nov. 1967). 11p. Dep. CFSTI (U. S. Sales Only).

Changes in the amount of radioactive fallout in atmospheric dust and precipitation (rain and snow) in Niigata City, Japan were observed from 1960 to 1962. The annual accumulation of radioactive atmospheric dust and precipitation was lowest in 1960 following the suspension of nuclear tests in 1958. However, both increased drastically in 1961 and 1962 following the resumption of tests. Highly radioactive particles were observed in October 1961 due to a major test in the USSR, and, quantitatively, the radioactivity was similar to fallout measurements made in 1959. The deposition of radioactive fallout in atmospheric dust and precipitation tended to be small in spring and summer and greater in autum and winter which verified previous indications of the seasonal nature of radioactive fallout deposition in this region. (L.C.L.)

47644 (NSJ-tr-149) DEPOSITION OF RADIOACTIVE FALLOUT IN NIIGATA CITY, JAPAN. REPORT III. RADIOACTIVE CONTAMINATION OF RAIN, SNOW, AND ATMOSPHERIC DUST OBSERVED IN 1965 AND 1966. Takizawa, Yukio; Sugai, Ryuichi; Kosaka, Takao. Translated from Niigati Igakkai Zasshi, 81: 664-7(Dec. 1967). 8p. Dep. CFSTI (U. S. Sales Only).

Measurements of the radioactive fallout in rain, snow, and atmospheric dust in Niigata City in 1965 and 1966 resulted in the following conclusions: the radioactivity in rain, snow, and atmospheric dust decreased somewhat in 1965, compared with the preceding year, but in 1966 it increased two-fold from 1965, due to the three nuclear tests in mainland China; the seasonal changes in fallout in the two years were different from those in the previous years, the amounts being high in spring and winter and low in summer and autumn; the falling of highly radioactive particles, due to the nuclear tests in May and December 1966, was considerable, and the amount in December 1966 marked the highest since 1954. In general, the state of nuclear tests was well reflected in the state of fallout, especially of atmospheric dust. (auth)

47645 (PNE-955) CABRIOLET: SPECIAL CLOUD CONTENT STUDIES. Cohen, J. J. (California Univ., Livermore. Lawrence Radiation Lab.). June 1968. 20p. (UCRL-50452). Dep. CFSTI.

Special studies of the cloud resulting from the Cabriolet Event were conducted to investigate: the nature of variance of concentrations of radioactivity within the cloud ("cloud lumpiness"); cloud dimensions; particle size distribution of the radioactive particulates; and the physical state of radioiodine. Cloud sampling for this investigation was accomplished by means of parachute-borne and ground-based air sampling equipment. The results of these studies are presented and discussed. (auth)

47646 (UCRL-Trans-10355) STUDIES ON FALLOUT PARTICLES. VII. Mamuro, Tetsuo; Matsunami, Tadao. Translated by T. Sakuragi for Univ. of California, Lawrence Radiation Lab., Livermore, from Nippon Genshiryoku Gakkaishi, 8: 416-23(1966). 20p. Dep. CFSTI.

Three kinds of highly radioactive fallout particles — originating respectively from a Soviet large scale air burst occurring in autumn 1962. The first Chinese explosion (small scale land surface burst, and the second Chinese explosion (small scale air burst) — have been measured by α spectrometry for activity due to ^{239}Pu and ^{240}Pu, and by γ spectrometry for ^{144}Ce and ^{95}Zr + ^{95}Nb activity. Differences found in the specific activity of these nuclides and in their composition ratio among the three kinds of particles are discussed in connection with the conditions of the explosions from which they originated. The ratio of α-activity to total activity ($\alpha/(\alpha + \beta)$) has been found to be considerably smaller in the collected particles than in the rain waters sampled in the periods immediately preceding and following the collection of the particles. The mean Pu concentration in the rainwater samples collected in the period from 1962 to 1965 has been found to be about 1×10^{-3} dps/l. (auth)

47647 TRITIUM PROFILES IN TWO FIRN CORES FROM ALPINE GLACIERS AND TRITIUM CONTENT IN PRECIPITATION IN THE ALPINE AREA. Ambach, W.; Eisner, H.; Sauzay, G. (Univ., Innsbruck). Arch. Meteorol., Geophys. Bioklimatol., Ser. B, 17: 93-104(1969).

Estimates were made of the tritium levels in precipitation in Central Europe prior to 1961, using the tritium profiles in 2 Alpine glaciers. The results obtained by this method were compared with those estimated by correlation analysis between Vienna and Ottawa data. In the Kesselwandferner (Oetztal Alps, Austria) samples were collected at 3240 m altitude during the summer of 1963. A continuous series of samples were taken in a 20 m deep vertical pit from places located 20 cm behind the pit wall. At Jungfraujoch (Berner Oberland, Switzerland), sampling was also carried out, on the ice-sheet at 3450 m. The maximum depth of sampling (carried out by means of an auger) was 12 m, and the individual samples consisted of 15- to 20-cm long sections of the core. Vertical distribution of radioactive fission products was investigated as well as the tritium content of the firn layers. Results are displayed in terms of density profile, pollen profile, and the profile of tritium content in the firn layers. The pollen and tritium profiles showed fundamental differences. The pollen profile was characterized by narrow and distinct maxima showing the concentration of deposited pollen grains in the firn layers, while in the tritium profile a smoothing of the expected fluctuations in the tritium content of the firn layers was observed. The expected peaks of tritium concentration in precipitation could be identified in accord with thermonuclear tests, as seen in the firn deposits of 1954, 1956, 1958, 1959, 1962, and 1963. All values given by both Kesselwandferner and Jungfraujoch studies showed good agreement with the tritium content of Vienna precipitation obtained by using correlation analysis with Ottawa data. Only 1956 peaks did not agree and were significantly higher in the firn. (BBB)

47648 ATMOSPHERIC DIFFUSION OF ^{41}Ar FROM THE CIRUS STACK AT TROMBAY. Sachdev, R. N.; Nadgir, S. B. (Bhabha Atomic Research Centre, Bombay). J. Appl. Meteorol., 8: 527-32(Aug. 1969).

Real-time downwind measurements of ^{41}A from the CIRUS stack at Trombay have been made at one of the micrometeorological stations, using the differential beta-gamma counting method. Simultaneous measurements of the standard deviation of horizontal wind direction fluctuations have also been made. These measurements have made it possible to study the variation of concentration of argon-41 with sampling period as a function of atmospheric stability. A comparison has also been made of concentrations of ^{41}A measured using the above method and computed with a knowledge of the standard deviation of horizontal wind direction fluctuations. (auth)

47649 FISSION PRODUCTS OF THE CHINESE NUCLEAR EXPLOSIONS DETECTED ON THE TERRITORY OF THE G.D.R. Zindler, H. (Staatliche Zentrale fuer Strahlenschutz, Berlin). Kernenergie, 12: 216-20(June 1969). (In German).

Fresh fission product mixtures have been detected in air, atmospheric precipitations, and fallout in the German Democratic Republic territory after all nuclear tests performed in China so far. The increase of atmospheric radioactivity after the four nuclear tests performed between October 1964 and October 1966 was only short-lived. Only the fission products from the fifth Chinese nuclear explosion at the end of 1966 had influence on the territory for a longer time. These fission products were detected by measuring the comparatively short-lived ^{89}Sr in the precipitations for about five months. The fission products of the sixth Chinese nuclear explosion which probably reached the stratosphere for the greater part were only detected for a short time by determining the simple nuclides in the precipitations, while the fission products of the nuclear explosion at the end of 1967 again were well detectable by a significant growth of the total specific beta activity and an elevated ^{89}Sr/^{90}Sr ratio in the precipitations. ^{144}Ce, ^{103}Ru, and ^{95}Zr + ^{95}Nb have been determined in the fallout samples by a gamma-spectrometric technique, ^{131}I by a radiochemical method. Studies of the explosion date following the t^{-1} law showed the specular growth of total beta activity in the near-soil layers of air in the early months of 1968 to be caused by the fission products of this seventh Chinese nuclear explosion and never by the inflow of older fission production from the stratospheric reservoir. (auth)

47650 TOTAL GROUND DEPOSITION OF ^{90}Sr IN JAPAN. 1. Yamagata, Noboru (Inst. of Public Health, Tokyo); Chiba, Morito; Kobayashi, Hironobu J. Radiat. Res., 10: 62-72(June 1969).

In view of the discrepancies between some data on soil analysis, and the accumulated deposition of ^{90}Sr technical errors in the analysis and sampling errors due to the horizontal surface distribution were examined. The NaOH–HCl leach method was found to be the best among the conventional substitutes for the standard fusion method and an interlaboratory comparison also probed the applicability of this method as a standard. A study was made of how to obtain a representative sample from an area of 1000 m^2 at a particular location. Statistical analysis of data obtained from undisturbed rice- and wheat fields suggested that to get a confidential limit of 10% at least 10, 4, and 8 cores, respectively, should be taken for making a composite sample. A preliminary study on the vertical distribution was also made in undisturbed soils. The amount in the upper 10 cm layer was 81.3% on the average of the total to the depth of 30 to 50 cm in different soil profiles. (auth)

47651 ^{90}Sr AND ^{137}Cs RADIOACTIVE CONTAMINATION OF THE DEMOCRITE CENTER REGION (GREECE) DURING 1965 AND 1966. Douvoyiannis, J.; Mimikos, N. (Democritus Nuclear Research Center, Athens). Chim. Chron. (Athens, Greece), 32A: 97-103(1967). (In Greek).

Worldwide levels of fallout are reviewed, and levels of ^{90}Sr and ^{137}Cs determined in Athens in 1965 and 1966 are reported. In 1965 the fallout levels were 3.50 mCi $^{90}Sr/km^2$ and 4.89 mCi $^{137}Cs/km^2$. The corresponding values for 1966 were 1.92 and 2.35 mCi/km^2. The mean values in milk in 1965 and 1966 were 7.39 and 6.20 pCi/l for ^{90}Sr, and 45.5 and 13.6 pCi/l ^{137}Cs. There was a marked decrease in radio-cesium levels in milk during this period. The mean concentrations of ^{90}Sr and ^{137}Cs in drinking water (from Lake Marathon) were 1.0 and 0.3 pCi/l, respectively. The total fallout in terms of ^{90}Sr was estimated to be 36.0 mCi/km^2 at the end of 1965 and 39.4 mCi/km^2 at the end of 1966. The corresponding values for ^{137}Cs were 52.0 and 54.0 mCi/km^2. The monthly values for each of these levels is tabulated. (BBB)

47652 GAMMA RAY SPECTROMETRY OF THE NATURAL RADIOACTIVITY IN THE AIRBORNE DUST. Oki, Iwashiro; Tamura, Sachiko (Osaka Prefectural Inst. of Public Health). J. Radiat. Res., 10: 78-82(June 1969).

By means of γ spectrometry, a qualitative variation in the diurnal variation of the natural radioactivity in the airborne dust was observed. The radioactive decay rate of the total natural radioactivity in the airborne dust collected during the day was higher than that collected during the night. It was found that the ratio of $^{212}Pb(Th,B)$ γ activity to the total γ activity was higher in the night and lower in the day, on the other hand, the ratios of $^{214}Pb(Ra,B)$ and $^{214}Bi(Ra,C)$ were a little higher in the day than in the night. From the observations, it was concluded that the quantitative diurnal variation of the natural radioactivity in the airborne dust was associated also with the qualitative variation derived from the variation in the abundance ratio of nuclide. (auth)

Mineralogy and Exploration

Refer also to abstract 47743.

47653 (CONF-690815-2) THE URANIUM INDUSTRY. Geology Paper No. 4. Stewart, J. R. (Australian Atomic Energy Commission, Coogee). Mar. 13, 1969. 10p. Dep. CFSTI (U. S. Sales Only).

From Conference of the Australian Institute of Mining and Metallurgy, Sydney, Australia.

The uranium supply and demand situation in the U.S.A., Canada, South Africa, France, the United Kingdom, and Japan and some other countries is briefly reviewed. The Australian Government's policy relating to uranium search is outlined and uranium prospecting activity in Australia by a number of companies is discussed. (Australia)

47654 PROSPECTS FOR URANIUM IN AUSTRALIA. Gourlay, A. J. (Commonwealth Bureau of Mineral Resources, Geology, and Geophysics, Canberra, Australia). Aust. Miner. Ind., 21: 58-66(Mar. 1969).

Limited uranium reserves in Australia make a government policy of conservation of resources and encouragement of exploration necessary. In May 1967 the total reserves were 14,750 short tons. Recent exploration has led to the discovery of significant additional reserves. Only one plant out of five constructed from 1954 to 1959 for the production of uranium concentrates remains in operation. In discussions concerning the outlook for possible introduction of nuclear power stations commenced in 1969, emphasis is placed on the desirability of at least the first few reactors being of the same basic type and in ensuring that the reactors will be independent of overseas fuel supplies. Introduction of nuclear power stations in Australia cannot as yet be justified on purely economic grounds. (Australia)

47655 INFLUENCE OF ROCK COMPOSITION UPON FORMATION OF EPIGENIC CONCENTRATIONS OF URANIUM. Kashirtseva, M. F. Sov. Geol., No. 6, 65-75(June 1968). (In Russian).

Various factors influencing the formation of epigenic concentrations of uranium are reviewed. It was found that the most favorable environment for uranium was the rocks containing high amounts of easily oxidizable minerals of pyritic geochemical type containing no more than 0.3% iron sulfide. Less favorable environments were chloride-siderite rocks in which iron sulfide minerals did not exceed 0.1 wt % of the rock. The environment with iron predominantly in a form of broken rock and with low sulfide content (0.2 to 0.3%) was less favorable for the infiltration of concentrations of U, Se, Mo, Pb, Fe and other elements. (R.V.J.)

47656 ABOUT THE GEOCHEMISTRY OF URANIUM AND THORIUM IN GRANITOIDS OF THE NEAR-POLAR URAL REGION. Kalinin, E. P.; Goldin, B. A.; Fishman, M. V. (Inst. of Geology, Moscow). Geokhimiya, No. 8, 1016-22(Aug. 1969). (In Russian).

The uranium and thorium contents in the near-polar region of Ural Mountains were studied. The relation between the modal and chemical composition of granitoids and the content of radioactive elements in them was investigated. Correlation analysis and geological data revealed that the geochemical character of granite magma is an important factor in the distribution of radioactive elements. Moreover, uranium formed mostly in potassium granites with a low anorthite index and thorium was found in sodium-type granitoids. (R.V.J.)

47657 REVIEW OF URANIUM ORE PROCESSING RESEARCH. Smith, S. E.; White, P. A. S. Afr. Mining Eng. J., 80: 862-70 (Apr. 18, 1969).

The general pattern of the treatment processes used for U extraction from the ore grades at present economics has now become standardized. The extent and nature of further improvements are likely to be fairly small, though the result would represent a significant saving to offset rising cost of labor, materials, and capital charges, and the need to process lower grade, less economic ore. Probable improvements include the introduction of Aerofall and autogenous grinding mills, improved leach circuits, application of pressure leaching, solvent extraction purification, and a limited degree of automatic control, ore upgrading by improved versions of lump sorters, and the wider use of bacterial leaching as an adjunct to the main mill process. Possible improvements could be made by further research and development in introduction of bacterial leaching for the whole ore, much improved methods of ore upgrading of wider applicability, in pulp extraction, and full automation of the mill processes for the next generation. Beyond this date problems of the treatment of lower grade ores, shales, and phosphates, and such techniques as underground nuclear blasing and in situ extraction, should be studied. Approximate percent breakdown of direct operating costs of U milling and extraction in 1967 are given for Canada, the U. S. A., and Australia. (BBB)

47658 O MESTOROZHDENIYAKH URANA V ZHELEZORUDNYKH FORMATSIYAKH DOKEMBRIYA. (Uranium Deposits in Iron Ore Decambrian Formation). Petrov, R. P.; Karpenko, V. S.; Meshcherskii, Yu. A. Moscow, Atomizdat, 1969. 72p.

The distribution of uranium deposits in decambrian iron ore deposits was studied. A brief review is given on decambrian formations of uranium metasomatic deposits. Data on the basic tectonic elements controlling ore deposits, mineralization zones, and uranium mineral associations are analyzed. The absence of a direct genetic bond between the iron and uranium deposits was noticed and the favorable alkali and carbonate metasomatism and related uranium mineralization in iron-rich decambrian layers are discussed. (62 references). (R.V.J.)

47659 MICROSCOPIC ICONOGRAPHY OF SOME MINERALS FROM URANIFEROUS DEPOSITS IN FRANCE AND GABUN. Agrinier, Henri; Geffroy, Jacques (CEN, Fontenay-aux-Roses, France). Bull. Inform. Sci. Tech. (Paris), No. 137, 77-81(May 1969). (In French).

A series of microphotographs of uncommon coloured metallic minerals associated with pitchblende are presented. All except one refer to polished sections. A microphotograph of a thin sheet of coffinite is included; this is a uranous silicate common in French uraniferous veins, but the aspect shown is very characteristic. (auth)

47660 SOME PECULIARITIES OF URANIUM AND THORIUM DISTRIBUTION IN EFFUSIVE ROCKS OF THE AMYL-KANDAT TROUGH (EASTERN SAYAN). Kovalev, V. P. (Inst. of Geology and Geophysics, Novosibirsk, USSR). Geokhimiya, No. 9, 1112-19(Sept. 1969). (In Russian).

Effusives richer in uranium and thorium are the youngest by age

and the most acid by composition. Two successively alternating parent magmae participated in their formation. The uneven increase of uranium contents in andesites and dacites is probably connected with the upwards shifting of the region of volcano alimentation. The increase of the thorium–uranium ratio shows the existence of a direct dependence on the alkali content. (auth)

Oceanography

47661 COSMIC-RAY-PRODUCED ^{32}Si IN NEAR-COASTAL WATERS. Somayajulu, B. L. K. (Tata Inst. of Fundamental Research, Bombay). Proc. Indian Acad. Sci., Sect. A, 69: 338-46(June 1969).

The specific activity of silicon-32 is measured is near-coastal sea-waters using an in situ method for the extraction of dissolved silica. The results are discussed in relation to the input of ^{32}Si at the surface via rains, the expected variation in its concentrations due to continental run-off, and influx of open ocean surface waters. The experimental results clearly demonstrate the usefulness of ^{32}Si as a tracer for the study of the vertical structure of the ocean in the upper layers, and of seasonal variations in the types of waters entering in the coastal regions. (auth)

ENGINEERING

Nuclear Explosions

Refer also to abstracts 47587, 47624, 47628, 47645, 47646, and 47649.

47662 (NVO–48) REVIEWS TO INSURE SAFETY OF NUCLEAR OPERATIONS. (Nevada Operations Office (AEC), Las Vegas). July 1969. 13p. Dep. CFSTI.

The work of the Nevada Operations Office (NVO) of the USAEC in predicting, observing, and reviewing the effects of US nuclear explosions on the safety of people and property is summarized and previous NVO experience briefly evaluated. Tables of information on the responsibilities of particular organizations and individuals working with nuclear detonations and the NVO effects evaluation program are presented. (L.C.L.)

47663 (PNE-G–48) QUESTIONS AND ANSWERS TO THE COLORADO COMMITTEE FOR ENVIRONMENTAL INFORMATION. (Nevada Operations Office (AEC), Las Vegas). 1969. 80p. Dep. CFSTI.

Answers are given to 24 questions asked by the Colorado Committee for Environmental Information relating to the planned Rulison underground nuclear explosion in Colorado. Included are details about the results of the December 10, 1967 Gasbuggy such as the production and transport of radioisotopes in that experiment, i.e., the contamination of the atmosphere, soil, and water in the explosion area. Also included are preshot geologic and hydrologic data obtained for the Rulison shot. (L.C.L.)

47664 (UCRL–50656) FISSION GAS RELEASE CURVES: GROWTH AND DECAY FROM FISSION OF ^{239}Pu BY FISSION SPECTRUM NEUTRONS. Barg, D. C.; King, W. C. (California Univ., Livermore. Lawrence Radiation Lab.). May 1969. 516p. Dep. CFSTI.

Fission gases from underground nuclear explosions occasionally escape and are vented to the atmosphere. A computer program was used to calculate the amounts of these gases and their daughter products remaining at various times after release. Tables and curves for all fission gas isotopes formed from the fission of ^{239}Pu by fission spectrum neutrons (from ^{85}Kr through ^{96}Kr, and from ^{133}Xe through ^{143}Xe) are presented, including growth and decay of the daughter products. Decay was computed from 10^{-2} min (0.6 sec) after release to 10^{6} min (~1.9 yr) after release. Separate tables and curves are presented for the following release times: zero time (prompt release), 1, 5, 10, 30, and 60 min following fissioning. (auth)

47665 (UCRL-Trans–10372) THE NUCLEAR EXPLOSIVE, A POTENTIAL ASSET TO CHEMICAL INDUSTRY. Cohen, P.; Dupuis, M.; Picq, S. M. Translated for Univ. of California, Lawrence Radiation Lab., Livermore, from Energ. Nucl. (Paris), 10: 224-30(1968). 13p. Dep. CFSTI.

The use of underground nuclear explosions as an asset to the chemical industry for the production of interesting basic materials, particularly gases, was explored. The three main processes by which gases are produced during such an explosion are irradiation, mechanical release due to breaking up of the containment material, and by in situ chemical reactions caused by the thermal and pressure energies of the explosion. Data from French experiments in granite are used to calculate the quality and quantity of gases thus formed, and to compare the calculated and measured results. An example is given of how to apply the same method to the calculation of gas production for an explosion in a bituminous schist. (L.C.L.)

47666 UNDERCUTTING OF NUCLEARLY DETONATED FORMATIONS BY SUBSEQUENT NUCLEAR DETONATIONS AT GREATER DEPTH AND USES THEREOF IN THE RECOVERY OF VARIOUS MINERALS. Dixon, Rod P. (to American Oil Shale Corp.). U. S. Patent 3,465,818. Filed Nov. 7, 1967.

By detonating a large size nuclear device below a column of broken mineral rubble created by an earlier nuclear detonation, the rubble is crushed to a fine average particle size while the overall permeability of the broken formation is increased as the column of broken material settles into the cavity created by the subsequent nuclear detonation. When using this technique in an oil shale formation, a hot retort gas may be passed through the broken formation either before or after, or both before and after, the second detonation to distill hydrocarbons from the detonated formation. In metal ore formations an extractive liquid solvent or a liquid flotation medium may be injected into the formation between the two consecutive detonations whereby the second detonation forces the injected treating liquid upwardly through the broken formation, increases the permeability of the latter, and facilitates in situ extraction or flotation. (Offic. Gaz.)

47667 USE OF NUCLEAR DETONATIONS IN PRODUCING HYDROCARBONS FROM AN UNDERGROUND FORMATION. Dixon, Rod P. (to American Oil Shale Corp.). U. S. Patent 3,465,819. Filed Apr. 13, 1967.

Nuclearly detonated formations are generally very extensive in scope and therefore it is difficult to drive hydrocarbons therefrom without channeling. When underground retorting of the nuclear rubble is resorted to in order to improve product recovery, residual heat is wastefully left behind. An invention is described which limits and controls the extent of caving of the hydrocarbon bearing stratum and thereby avoids or substantially reduces the problem of channeling. It also maximizes the utilization of the thermal energy released in retorting by caving portions of untreated hydrocarbon bearing stratum onto the hot ash left from a previous retorting step and using the heat in the ash to distill hydrocarbons from the as yet untreated portions. (Offic. Gaz.)

Facilities and Equipment

Refer also to abstracts 47718, 48297, 48314, 48383, 48867, 49249, and 49286.

47668 (AI-AEC–12813) HIGH HEAT FLUX HEATER DEVELOPMENT. STATUS REPORT II. Babbe, E. L.; Shively, J. H.; Mahoney, M. W. (Atomics International, Canoga Park, Calif.). July 15, 1969. Contract AT(04-3)-701. 35p. Dep. CFSTI.

Electrical heaters that produce surface heat fluxes exceeding 1.0×10^{6} Btu/ft^{2}-hr are being successfully used for fuel cladding tests in sodium. A continuing program, to increase heater life while collecting cladding test data, has yielded design changes which have been tested and analyzed. The major factors affecting heater life are the compatibility of heater component materials, and design accommodation of dimensional changes during service. Two important modifications to the heater were; a rhenium disc for the upper diffusion barrier, and a hollow graphite heating element with solid end plugs. Both modifications proved to be successful in extending heater life. The heater reference design now includes a rhenium wafter as an upper diffusion barrier, with a solid graphite heating element. A backup design utilizes a hollow graphite heating element with solid end plugs and, as yet, an undetermined upper diffusion barrier. (auth)

47669 (EIR–156) HELIUM TURBINES WITHOUT RECUPERATORS. Frutschi, H. U. (Eidgenoessisches Institut fuer Reaktorforschung, Wuerenlingen (Switzerland)). May 1969. 9p. (In German). Dep.

A study was made to determine the cycle efficiencies and power outputs that could be attained with simple helium turbines without recuperators. The construction possibilities indicated by the results of the analysis were considered. Cycles without either an intermediate cooler or a recuperator and cycles with an intermediate cooler but without a recuperator were analyzed. A compact installation for a 1000 Mw(e) plant is described. (J.S.R.)

47670 (ORNL-TM–2625) DESIGN AND EVALUATION OF A LABORATORY COLD ROLLING MILL. Gibson, James R. (Oak Ridge National Lab., Tenn.). Oct. 1969. Contract W-7405-eng-26. 73p. Dep. CFSTI.

Thesis. Submitted to Univ. of Tennessee [Knoxville].

Design and evaluation of a laboratory cold rolling mill which is used to produce thin foils of all types of metal isotopes is reported. The mill design is based on requirements for rolling sheets of stainless steel to a specified thickness and uniformity. Emphasis is on operation of the backup rolls and work rolls with particular attention to deflection and stress distribution under maximum expected rolling load. The backup rolls are treated as simply supported beams under a uniformly distributed load. The work rolls are supported by the backup rolls and are set at a small diameter so as to reduce the separating force developed during reduction of the workpiece. The design of the remainder of the rolling mill components is based on the separating force developed at the work rolls. The evaluation of the rolling mill was performed by rolling several sample sheets of stainless steel to the final required thickness under the condition of maximum reduction. The variation in thickness across these samples which reflected the roll deflection was measured and compared with the

maximum roll deflection determined mathematically. These measurements were very close to those predicted by the mathematical treatment. Several more samples were rolled to determine that the requirements on uniformity could be achieved which was also successfully completed. (auth)

47671 IRRADIATION APPARATUS. Latzer, B. (to Sulzer Brothers Ltd.). Canadian Patent 816,256. June 24, 1969. Priority date June 1, 1964, Switzerland.

A radiation-absorbing mass has an arcuate passage of circular cross section with a cylindrical enlargement intermediate between its two ends. A ring of radiation-absorbing material moves on rollers through the passage. It contains a number of recesses for reception of the material to be irradiated. The cross section of the ring is about equal to that of the passage and a rotatable annular support fits within the enlargement around the ring for the support of the rod-like radiation sources. A suitable aperture is provided for the insertion and withdrawal of the sources. (F.S.A.)

47672 APPARATUS FOR IRRADIATING BATCHES OF ARTICLES. Curnow, E. K. (to Atomic Energy of Canada Ltd.). Canadian Patent 815,127. June 10, 1969.

A batch irradiation apparatus is enclosed in a housing which serves also as a shield for the operators. It contains turntables mounted for rotation about vertical axes so that uniform radiation of the articles is attained. Safeguards are provided so that the door cannot be opened while the source is in the radiation position. Various other protective schemes are described for safe operation of the device. (F.S.A.)

47673 IMPROVEMENTS IN OR RELATING TO PRESSURE VESSELS. Jubb, Albert (to Rolls-Royce Ltd.). British Patent 1,161,670. Aug. 20, 1969. Filed July 17, 1968.

Reference is made to prestressed concrete pressure vessels for nuclear power plants comprising a reactor and a closed cycle gas turbine. In such systems it is desirable that at least the gas turbine should be removable for maintenance purposes, necessitating provision of an opening in the pressure vessel. A closure member for such an opening is described, which does not substantially detract from the integrity of the pressure vessel. It comprises two relatively movable parts, one of which is adapted to close the pressure vessel opening and the other is spaced from the pressure vessel by the first part and adapted to be secured to the pressure vessel at at least two points by at least one cable or similar stressing means, the arrangement being such that, to close the pressure vessel the parts are relatively moved so as to increase the cable tension, the tension operating via the second part to urge the first part into engagement with the portion of the pressure vessel surrounding the opening. A source of high pressure fluid may be used to effect movement of the parts. Both parts may comprise steel lids, with the second steel lid covered with a layer of concrete across which at least one cable passes. Preferably the pressure vessel should be provided with a number of prestressing cables extending through it in a direction perpendicular to the opening, at least one cable passing over the aforesaid second part and being secured between a pair of prestressing cables disposed on opposite sides of the opening. The cables may be arranged in reticulate form over the second part. (UK)

47674 FLANGES OF A PRESSURE VESSEL. Hayashi, Tsutomu (to Hitachi Ltd.). Japanese Patent 1969-12353. June 4, 1969. Filed Sept. 14, 1966.

In a pressure vessel, an end plate is usually joined to the vessel cylinder by means of flanges, which are welded to the end plate and the cylinder, respectively. In fastening the two flanges together, bolts and nuts are used; stud bolts are fixed to the surface of the cylinder flange, and penetrate through holes drilled in the end plate flange. By the method proposed, stress in the bolts, occurring during the pressure-vessel operation, can be reduced. This stress and also the bending moment are caused by deformation of the pressure vessel due to heat and internal pressure. In fastening the upper and lower flanges by means of bolts and nuts, the stud bolts tend to be bent by force due to contact between the nuts and the upper-flange surface. By using suitably shaped washers under the nuts, some displacement of the bolts occurs prior to fastening. Then, upon actual fastening, this displacement is removed, and the bolts are brought to the original upright position. (NSA of Japan)

47675 DOUBLE-END-WELD PENETRATION ASSEMBLIES UPGRADE REACTOR CONTAINMENT RELIABILITY. Sorsensen, D. K. (General Electric Co., San Jose, Calif.). Power, 113: No. 9, 72-3(Sept. 1969).

The double-end-weld penetration assembly has been successfully used in water-cooled reactors. Features of this electrical penetration assembly include redundant containment barriers, recessed headers, stress minimization, load compensation, and provision for radiation shielding. The installation procedures are described. Other penetration designs including canister, capsule, and flanged forms are briefly described. (J.C.W.)

47676 THE STATE OF CONSTRUCTION OF THE MIHAMA ATOMIC POWER STATION. Okano, Shigeo (Kansai Electric Power Co., Osaka). Sangyo To Denki, No. 20, 2-7(May 1969). (In Japanese).

The Mihama atomic power station of Kansai Electric Power Company, which is being built on the Tsuruga Peninsula, Fukui Prefecture, has No. 1 and No. 2 power plants with pressurized water reactors of 340,000 and 500,000 kW respectively; No. 1 plant will go into operation in October 1970 and No. 2 plant in June 1972. At the end of February 1969, 540,000 man days have been used in the construction of the power station. Concerning the Mihama atomic power station, the following are discussed: an outline of the power station; the state of construction of the power station, including ground leveling, the piers of harbor, seawater conduits, reactors, turbogenerators and the housing building; the plant safety inspections, and radiation shielding and earthquake-proof design. (NSA of Japan)

47677 OPTIMUM RATIOS IN FLAT INDUCTION PUMPS WITHOUT SHORT-CIRCUIT BUSBARS. Valuev, Yu. A. Magn. Gidrodin., Akad. Nauk Lat. SSR, No. 1, 99-104(Jan.-Mar. 1969). (In Russian).

Methods are presented for optimization of flat linear induction pumps without side short-circuit busbars. Estimates of maximum efficiency were considered as a problem of nonlinear programming and a computer was used for its resolution. The main contrast of the proposed method consists of the calculation of additional losses dependent on the phenomena in the pump channel, which are related to the influence of a traveling magnetic field. It was concluded that it is possible to optimize the pump using two variables: the number of poles and the slip. (M.C.G.)

47678 USE OF TRADITIONAL STRUCTURE COMPONENTS FOR STEAM GENERATIONS IN NUCLEAR POWER STATIONS. Bitterlich, Eberhard (Firma L. and C. Steinmueller GmbH, Gummersbach, Ger.). Energ. Tech., 20: 241-9(Aug. 1968). (In German).

A survey is given of the structural components known from conventional power plants which can be used in the various reactor types. The discussion is limited to a description of converter components. It was found by use of examples that for firms already in conventional power plant construction, competition in the nuclear power field is feasible. (tr-auth)

47679 THE EFFECT OF FILTRATION AND VOLTAGE ON THE RADIATION EXPOSURE OF PATIENT AND EXAMINER. Boesche, Hermann. Strahlenschutz Forsch. Prax., 7: 61-70 (1967). (In German).

Effects of various filters and voltages on radiation exposures of patients are reviewed and discussed. It was found that in the diagnostic 50-KV x-ray range supplemental filters of 2 to 4 mm of Al or 0.1 to 0.2 mm of Fe had to be used in addition to the usual tube filters in order to reduce the volume irradiation dose and the gonadal dose by 25 to 50%. Carbon steel filters were most effective. For diagnosis and radiotherapy, the most advantageous filters for various voltages were cellon, Al, Fe, and Zr, for 25, 25 to 50, 50 to 150, and 150 to 300 KV, respectively. Relations between surface dose, exit dose, film dose, and x-ray voltage were discussed. Studies of gonadal doses that were calculated by use of water phantoms were reported. Magnitudes and coordinates of stray irradiation fields were measured for 90-KV fluoroscopes. Effects of x-ray voltages on distribution of stray irradiation, at 75 to 150 KV measured to be 6 and 4 mR, in air, were decreased to 0.02 and 0.04 mR, respectively by use of a rubberized Pb apron with a Pb equivalent of 0.5 min. (BBB)

47680 LIMITS OF PRODUCTION OF VERY HIGH MAGNETIC FIELDS. Lehner, Guenther (Max-Planck-Gesellschaft, Garching, Ger.). Ergeb. Exakten Naturwiss., 47: 67-110(1968). (In German).

The flux concentration and azimuthal field compression methods used for the production of very high fields are briefly outlined. The limitations placed on the production of very high magnetic fields by the characteristics of these methods are discussed. The degree to which magnetic field produced by the compression of magnetic flux can be limited by the effect of the finite electrical conductivity is calculated. The dynamic limitations caused by the effects of the explosive on the liner in field compression are also calculated. It is shown that the liner can be unstable on its internal surface. 61 references. (J.S.R.)

47681 A RADON DAUGHTER REMOVAL CHARACTERISTIC OF THE VARIOUS AIR-PURIFYING RESPIRATORS. Kurosawa,

Ryuhei (Waseda Univ., Tokyo). Waseda Daigaku Rikogaku Kenkyusho Hokoku, No. 44, 15-24(May 1969). (In Japanese).

The radon daughter removal characteristics for respirator filtering materials were studied to protect against radiological hazards due to alpha activities of the inhaled radon daughters, especially ^{218}Po. To estimate the removal factor of the filtering materials used in the respirator, the leakage concentration of ^{218}Po from the testing filters were compared with that of the original air. The equations are presented. (auth) (NSA of Japan)

47682 OPERANT ELECTROMAGNETIC CHAMBER. Caldwell, Willard E.; Gaddis, Earl; Werber, Morton (George Washington Univ., [Washington, D. C.]). J. Genet. Psychol., 115: 7-16 (Sept. 1969).

Apparatus for studying the effects of weak intensity radio waves on the behavior of small animals such as mice and gerbils is described, and preliminary results are presented. (W.H.K.)

47683 DEVICE FOR CONDUCTING CRUSHING AND SCREENING OPERATIONS SIMULTANEOUSLY. Ardary, Z. L. (to United States Atomic Energy Commission). U. S. Patent 3,465,972. Sept. 9, 1969.

A device for conducting crushing and screening operations simultaneously is described in which the material being crushed is placed in a hollow rotatably mounted cylinder. Crushing action is provided by a solid metal rod disposed inside the cylinder. As the cylinder rotates, the bar is picked up by a pair of dogs at the bottom of the cylinder and dropped from the top, thereby crushing any material caught between the bar and the wall. A portion of the wall of the cylinder is made of a selected size screen so that on each revolution of the cylinder the crushed material falls through the screen into a receptacle and is not left in the cylinder to produce fines from subsequent crushings. This device is quite useful in situations where it is desirous to obtain a narrow screen fraction of crushed particles in a very economical manner, and was specifically designed for preparing uranium dicarbide particles for use in reactor fuels. (AEC)

47684 THE ARCHITECT-ENGINEER-CONSTRUCTOR'S ROLE IN FUTURE NUCLEAR-DESALINATION PROJECTS. Selak, P. J.; Finke, J.; Lindsay, A. L. (Kaiser Engineers, Oakland, Calif.). pp 847-58 of Nuclear Desalination. New York, American Elsevier Publishing Co., Inc., 1969.

From Symposium on Nuclear Desalination, Madrid, Spain. See CONF-681108.

In the United States the traditional role of the architect-engineer-constructor has included economic and engineering studies to establish design criteria and concepts, select paint equipment and materials, integrate development of design engineering and procurement with established schedules, and expedite the design-to-construction transition. With the advent of large nuclear-power desalination facilities, associated with possible industrial and agricultural objectives, and with the concomitant enormity of the nuclear and desalination components involved, the architect-engineer-constructor's role becomes even more significant. Many major components such as reactor vessels and evaporator shells will have to be field-fabricated and an increasing application of pre-stressed, reinforced and other special concrete structures will be required. Reliability and quality assurance have already become paramount in the design of nuclear and desalination facilities. A seismic design, special containment structures, and other safeguards considerations have become the responsibility of the architect-engineer-constructor. Specialists in stress and thermal analyses, field and shop inspection, programming and application of computers in the solution of special engineering problems, hazards evaluation and safeguards engineering, economic and technical trade-off studies, and many others are required. Experience in the metallurgical and chemical process industries is needed to make optimum use of tomorrow's nuclear energy and water resources. (auth)

47685 UNITED KINGDOM DESALINATION RESEARCH AND DEVELOPMENT PROGRAM. Kronberger, H. (United Kingdom Atomic Energy Authority, Risley, Eng.). pp 33-40 of Nuclear Desalination. New York, American Elsevier Publishing Co., Inc., 1969.

From Symposium on Nuclear Desalination, Madrid, Spain. See CONF-681108.

In 1965 the UKAEA assumed responsibility for research into development of methods of desalting salt water. An initial three-year program at a cost of £1.3 million involved close collaboration with industry on processes including multi-stage flash distillation, (MSF), electrodialysis, the secondary refrigerant processes and reverse osmosis. Principal objectives are to exploit the development potential of the MSF distillation process and to explore alternative methods of desalination which might supersede MSF in the long term. In 1968 approval was given for the expenditure of a further £4 million in the period 1968 to 71. Almost half this sum will be used to finance agreed programs of work by the UKAEA with industrial collaborators. Project organization and the current and proposed areas of research and development are discussed. (auth)

Heat Transfer and Fluid Flow

Refer also to abstracts 47593, 48804, 49523, and 49557.

47686 (AECL-3027) EXPANSION CHARACTERISTICS OF LIQUID FLUIDIZED BEDS OF SPHERES. MacFarlane, R.; Armstrong, R. K.; Trupp, A. C. (Atomic Energy of Canada Ltd., Pinawa (Manitoba). Whiteshell Nuclear Research Establishment). June 1968. 79p. Dep. CFSTI (U. S. Sales Only).

Bed expansion characteristics were investigated for batch fluidization of uniformly sized glass, steel, and lead spheroids ranging in size from 1.2 to 9.7 mm diameter. Most of the experiments were conducted using water at room temperature to fluidize beds of up to 44 cm diameter. Particle Reynolds numbers were greater than 500 for all beds and ranged as high as 14,000. Archimedes numbers were in the range 2×10^5 to 7×10^7. Several tests were also carried out in an organic loop with columns up to 7.6 cm in diameter and liquid temperatures up to 200°C. The data were successfully correlated by the equation: $V_0 = 0.826\ (V_T)^{1.18}(\epsilon)^{2.28}$ for $Re > 500$ and $d/D < 0.06$ where V_0 = liquid superficial velocity (m/s), V_T = single sphere terminal velocity (m/s), ϵ = average bed porosity (liquid volume fraction), $Re = \rho_f V_T d/\mu_f$, d = spherical particle diameter, D = column (bed) diameter, and ρ_f and μ_f = liquid density and viscosity. The form of this equation was deduced from turbulence considerations. Experimental data and discussions of wall effect, packed height effect, and settled bed porosities are included. The problems experienced in obtaining good quality fluidization and the application of the experimental results to the design of a liquid fluidization bed nuclear reactor are discussed. (auth)

47687 (AECL-3186) ON-LINE COMPUTER APPLIED TO HEAT TRANSFER STUDIES. McGovern, T. (Atomic Energy of Canada Ltd., Pinawa (Manitoba). Whiteshell Nuclear Research Establishment). Dec. 1968. 13p. Dep. CFSTI (U. S. Sales Only). CAN $0.50.

A computer system was developed and installed to process data from an experimental heat transfer system. The system recorded coolant inlet and outlet temperature, temperature at the wall of the test specimen, and electrical power in the specimen. The computer was programmed to take these measurements, calculate heat flux and heat transfer coefficient. Output was in the form of graphs of heat flux and heat transfer coefficient versus wall temperature, and of a table of all input and output parameters. Power changes to the specimen were actuated manually by the operator, with the computer taking readings when the temperature has achieved equilibrium. (auth)

47688 (AERE-Trans-1114) VOIDS, FRICTION, AND VIBRATIONS ASSOCIATED WITH LOCALISED BOILING. Gregorio, P.; Merlini, C. (Politecnico di Torino (Italy)). Translated by R. Matthews for Atomic Energy Research Establishment, Harwell, Eng., from report PT-IN-24(1965). 29p. Dep. CFSTI (U. S. Sales Only). UK 4s. 6d.

A study of the literature shows that much work remains to be done in the field of local boiling as regards calculation and measurement of voids, determination of the coefficients of friction, and the origin and propagation of vibratory phenomena. From the experimental work, it was concluded that the model proposed by Bowring (Report HPR-10(1962)) is still the most complete for tracing void profiles, assuming the factor ϵ not constant but variable with subcooling according to the law proposed in the present work. The void profiles obtained correspond more closely to the experimental data. In addition, the effective temperature of the liquid phase can be calculated by means of an iterative process. It reaches the saturation value only if it is assumed that the wall temperature rises gradually from the value in local boiling to the value of net boiling. (31 references). (auth) (UK)

47689 (ALO-3634-13) RESEARCH AND DEVELOPMENT OF VACUUM FOIL-TYPE INSULATION FOR RADIOISOTOPE POWER SYSTEMS. Quarterly Progress Report, March 1969-May 1969. Carvalho, J.; Dunlay, J. B.; Paquin, M. L.; Poirier, V. L. (Thermo Electron Corp., Waltham, Mass.). July 28, 1969. Contract AT(30-1)-3634. 27p. Dep. CFSTI.

Continuing work on the development of high-temperature thermal insulation is reported. Under uniform compressive stresses of 2.1 and 5.2 psi, insulation samples fabricated using 5 to 10 μ ZrO_2 particles transmitted lower heat fluxes than sim-

ilar samples fabricated using 15 to 25 μ ZrO_2 particles. Under certain conditions, up to a 40% difference was observed. The final five insulation samples fabricated for the reproducibility studies have been evaluated in the planar heat transfer test apparatus. The same samples were combined to produce a final set of layer variation data. The Low temperature heat transfer tests have been completed. Heat flux and thermal conductivity data are presented for 40 and 80 layers of SS–ZrO_2 insulation and 40 layers of Ti–ZrO_2 insulation. The four 10,000-hour life test systems have accumulated between 1000 and 1500 hours. An unidentified material condensed in the pyrometer holes, making temperature measurements difficult. (auth)

47690 (ANL–7563) STUDY OF TRANSIENT HEAT TRANSFER FROM A WATER-IMMERSED ALUMINUM FUEL-PLATE SAMPLE IN TREAT. Harrison, Lawrence J. (Argonne National Lab., Ill.). Apr. 1969. Contract W-31-109-eng-38. 41p. Dep. CFSTI.

During a photographic study of the chemical reactions between water and aluminum-alloy plate-type fuel samples subjected to nuclear transients, time-elapse and energy-input data were obtained for incipient nucleate boiling, stable film boiling, and high-temperature physical and chemical responses of the sample. These data were used to calculate the transient temperatures, heat fluxes, and heat losses from the samples. The modes of transient heat transfer considered were conduction, nucleate boiling, film boiling, and radiation, all under highly subcooled pool conditions. Calculations were begun at ambient temperature and are taken on past sample melting to high temperatures at which the chemical reaction occurs at a significant rate; one typical experiment had a calculated peak sample temperature of 1590°C. The transient energy-release rates were in the range from 100 to 200 msec, and all the experiments were conducted at 12.3 psia. The temperature range considered in this study far exceeded the ranges previously reported, and this is the only study which used reactor fuel as the heat source. Plots of time versus reactor power, energy release, sample temperature, and events in the fuel during a typical transient are included. (auth)

47691 (EURAEC–1710) STUDIES OF VORTEX FLOW FOR NUCLEAR APPLICATIONS. Final Report. Rosuel, A.; Sourioux, G.; Dolle, J.; Tournier, G.; Beghin, A. (Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Suresnes (France). Division Atomique). [nd]. Contract 061-64-7-TEEF. 143p. (In French). (EUR–2892). Dep.

Work performed under United States–Euratom Joint Research and Development Program.

Studies of vortex flow have shown both the hydrodynamic characteristics and the mechanisms governing boiling. The centrifugation of the flow permits the separation of phases at low vacuum fraction values. The range of velocities and vacuum fractions in which centrifugation remains low is very limited. The nature of the flow characterized by the distribution of phases (gas phase at the center of the vortex and liquid film at the wall) is not however altered by the laws relative to the definition of the two-phase pressure loss. The value of the total pressure loss is then affected only by the variation of the friction coefficient in the simple phase. The hydrodynamic study showed the importance of the phenomenon of distribution of the outputs in the channels of a cluster of rods. The knowledge of the local parameters defining the flow will necessitate the establishment of a model. This study showed the effects of the velocities and the void fractions on the significance of mass transfer from one channel to the other. It seems difficult not to take into consideration this phenomenon for the comprehension of boiling crisis in a cluster of rods. The thermal studies showed the important advantages that the bores can have on the thermal performance of a boiling reactor channel. The comprehension of the phenomena is necessary for the extrapolation of the results to other geometries. (tr-auth)

47692 (INR–976) SOME APPLICATIONS OF RESISTANCE ANALOG COMPUTER TO THE SOLVING OF HEAT CONDUCTION PROBLEMS. Strupczewski, A. (Institute of Nuclear Research, Warsaw (Poland)). 1968. 39p. Dep. CFSTI (U. S. Sales Only).

Several solutions of steady and unsteady state heat conduction problems reached on resistance analog computers illustrating various possibilities of their use are described. A comparison of time, precision, and costs of solutions is given for resistance analog computers and digital computers. (auth)

47693 (KFK–806) THE INFLUENCE OF GEOMETRICALLY DEFINED COEFFICIENT OF ROUGHNESS ON HEAT TRANSFER AND PRESSURE DROP IN LENGTHWISE FLOW THROUGH A 7-ROD BUNDLE. Casal, V.; Waggott, R. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorbauelemente). Nov. 1968. 66p. (In German). (EUR–3966). Dep. CFSTI (U. S. Sales Only).

The influence of a geometrically defined coefficient of roughness on heat transfer and pressure drop in lengthwise flow through a 7-rod bundle was studied. The results showed that roughness in the form of peripheral fins has a thermodynamic effect in spite of the slight increase of the spiral-like separator. The effects of the surface roughness on the thermodynamic and flow behavior of a flow in a 7-rod bundle agreed qualitatively with that previously determined for ring cleavage and quantitatively with bundle studies. By the application of fuel rods with various rod cross section, a considerable increase in heat transfer was attained with a moderate increase in pressure loss. The measurements showed that the chosen rod forms are still not optimum since the heat transfer increase decreased with increasing Reynolds number. The selected spacer — wire coils on the external rods — were not advantageous for the 7-rod bundle since they caused very non-uniform cooling. For the 7-rod bundle, surface roughness on the fuel rods for increase of the heat transfer resulted in unequal cooling between external rods and the central rod, and was largely influenced by the smooth wall of the cladding. (tr-auth)

47694 (KFK–894) ROD HEATERS WITH INDIRECT RESISTANCE HEATING FOR SIMULATION OF NUCLEAR FUEL RODS. Casal, V. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorbauelemente). Mar. 1969. 28p. (In German). Dep.

High load indirectly-heated heating rods were developed, instrumented, and tested for the simulation of nuclear fuel rods. They have the dimensions of the fuel rods of fast breeder reactors and exhibit at least the reactor rod output at the maximum cladding temperatures. With these instrumented rods, studies were made of the heat transfer of the fuel elements in air, steam, and water flows. The studies showed that the MgO insulated rods at surface temperatures of 700°C reach rod outputs of 300 W/cm. This can be increased in BN insulated rods at the same temperature to around 900 W/cm. (tr-auth)

47695 (KFK–925) SIMULATION OF COOLANT EJECTION IN THE Na-2 FUEL ELEMENT. Fette, P.; Grossgarten, H. D. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorentwicklung). Jan. 1969. 13p. (In German). (EUR–4169). Dep.

Bubble propagation in a rod bundle with fuel element dimensions was followed experimentally using optical methods. The experimental results indicated that, in perturbations in the reactor as a result of bubble formation due to overheating of the sodium, the bubbles formed completely fill the cross section of the fuel elements concerned. A calculation of the ejection processes after BLOW is based on a true definition of the bubble cross section surface. (tr-auth)

47696 (KFK–955) COMPARATIVE DYNAMIC INVESTIGATIONS ON A SODIUM-HEATED ONCE-THROUGH STEAM GENERATOR FOR MODERN NUCLEAR POWER PLANTS. Schoenfeld, E. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorentwicklung). Feb. 1969. 103p. (In German). Dep. CFSTI (U. S. Sales Only).

A new non-linear mathematical model was developed describing the dynamic behavior of a sodium-heated forced-flow steam generator. The model is suitable for non-stationary calculations, especially for serious interferences as load reversal processes and incidents. The dynamic behavior of temperature and site pressure changes in the system were considered in the model. Some characteristic accidents to the steam generator were calculated and compared with experimental studies on a 5-Mw sodium research steam generator. The comparison showed a remarkable agreement of the corresponding transfer functions. It was proved experimentally that the dynamics of the evaporation zone are well described by a double breakdown. Although the comparison was made only in the pressure interval between 60 and 90 atm, it was assumed that agreement was probable for higher pressures. (tr-auth)

47697 (N–69–30070) AN ANALOG COMPUTER STUDY OF THE LOW-FREQUENCY FLOW DYNAMICS OF TWO NUCLEAR ROCKET COLD-FLOW ENGINE SYSEMS. Fox, Harry W. Jr.; Blaha, Ronald J. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). July 1969. 85p. (NASA-TN-D-5312). CFSTI.

An analog computer study was made of the low-frequency flow dynamics observed with liquid hydrogen flowing in two different nuclear-rocket cold-flow (unfueled) engine systems. The prediction of the low-frequency response depends largely upon the generation of the proper mass-flow storage in the system. This is achieved by relating, in the model lumping, the average values of fluid enthalpy and a certain thermodynamic fluid property. A two-phase state equation is derived for thermodynamic equilibrium between the gas and liquid phases. Parametric studies were made

which demonstrate the effects of the pump characteristics on the flow damping. (auth) (STAR)

47698 (NP-18004) DETERMINATION OF LOSS OF PRESSURE IN CAPILLARY MEDIA CAPABLE OF BEING USED IN HEAT PIPES. Note TT No. 265. Schmidt, E. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Apr. 27, 1967. 41p. (In French). Dep. CFSTI (U. S. Sales Only).

The pressure loss in capillaries composed of several layers of a sieve with different meshes and placed horizontally in a square pipe was studied experimentally. The tests were made with water, but the results are valid for other liquids such as sodium. The coefficient of friction, f, was determined as a function of the Reynolds number (Re < 300) on the basis of the test results. (tr-auth)

47699 (NYO-3679-8) HEAT TRANSFER AND HYDRAULICS: THE EFFECTS OF SUBCOOLED VOIDS. Final Report, February 1967-June 1969. Staub, F. W.; Walmet, G. E. (General Electric Co., Schenectady, N. Y. Research and Development Center); Neimi, R. O. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). May 1969. Contract AT(30-1)-3679. 253p. (EURAEC-2120). Dep. CFSTI.

Work performed under United States-Euratom Joint Research and Development Program.

An experimental and analytical program directed toward the determination of the void distribution, location of the initiation of net vapor generation, pressure drop, and heat transfer coefficients in subcooled boiling water systems is described. The measurement of the initiation and early development of the subcooled void profile was carried out, including all required profile measurements and observations, with low-pressure water. Analytical formulations for the prediction of the subcooled flow boiling void fractions and pressure drop are presented. The void profile, pressure drop, and heat transfer measurements were extended to a reduced pressure range of 0.3 to 0.7, and the higher quality regions, using the Refrigerant-22 facility. Analytical formulations were compared with experimental data. Then the void profiles, pressure drop, and heat transfer coefficients were measured at a reduced pressure of about 0.4 to 0.5 in water to provide a check on the formulation. All water experiments were conducted with and without a reactivity and a pH control additive to determine their effect at both low and high pressures. General equations were derived which accurately predicted the void fraction, pressure drop, and heat transfer coefficients in two-phase flow with subcooled boiling for various fluids and over a wide range of operating conditions. Emphasis was placed on the formulation of the point where net vapor generation was initiated, in subcooled boiling, in terms of the surface and fluid properties, local geometry, and the operating characteristics of the system. (J.C.W.)

47700 (RD/B/N-1358) SHORT STUDY OF CAPILLARY ACTION IN BOILING WATER HEAT TRANSFER THROUGH POROUS MEDIA. Stratton, A. A.; Walker, W. N. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). July 1969. 17p. Dep. CFSTI (U. S. Sales Only).

Experiments were carried out to test the proposal that a boiling process involving capillary action occurs when porous layers are built up between a heat transfer surface and its liquid coolant. A theoretical model was also set up and compared with the experimental results. Tests with real porous media were inconclusive owing to poor thermal contacts. Experiments with a single capillary indicated that boiling within pores was explosive owing to restricted bubble expansion, and was only well predicted by the theory when the resulting meniscus movement was small. This condition is expected to hold in porous media, and, by application of the theory to these, it was found that this process may provide an efficient heat transfer mode. (auth) (UK)

47701 (SC-RR-69-303) ABLATION AND THERMAL ANALYSIS OF THE APOLLO LUNAR RADIOISOTOPIC HEATER. Larson, D. W. (Sandia Labs., Albuquerque, N. Mex.). July 1969. 137p. Dep. CFSTI.

The ablation and thermal response of the Apollo Lunar Radioisotopic Heater (ALRH) was determined for orbital decay atmospheric reentry, lunar return prompt reentries, and multiple orbit reentries from near lunar apogees. The temperature response of the ALRH was also determined for operational and other steady state conditions. (auth)

47702 (SGAE-RT-19/1968) INVESTIGATIONS OF THE DYNAMICS OF HEAT TRANSFER. 4th Report, 1968. Schmidl, H. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Institut fuer Reaktortechnik). 84p. (In German). Dep.

Experimental studies on the dynamics of heat transfer were made to test the validity of the assumption of a constant axial temperature coefficient of conductivity in the one-phase turbulent flow in a tube. The experimental results showed that the conventional model of one-phase turbulent flow leads to inaccurate results in short-time behavior. By assuming axial heat equilibrium within the liquid, it is possible to attain complete agreement with experiments. (tr-auth)

47703 (SU-326-P-13-4) STUDY OF FISSION-FRAGMENT-INDUCED NUCLEATION OF BUBBLES IN SUPERHEATED WATER. Deitrich, L. W. (Stanford Univ., Calif. Nuclear Engineering Lab.). Apr. 1969. Contract AT(04-3)-326. 107p. Dep. CFSTI.

Two theories proposed to explain the ability of radiation particles to produce bubbles in superheated water are that a bubble is created as a result of electrostatic repulsion between like-charged ions within a small cavity left by the particle traversing the liquid and that bubble formation is due to thermal energy deposited in the liquid as a thermal spike by the ionizing particle. The spike theory was applied to calculations in the experiment. The design and performance of the bubble chamber facility and auxiliary equipment are given. The experimental data are compared with the theoretical calculations. A $^{235}UO_2$ source was irradiated with neutrons from a reactor beam port at the Stanford Pool Reactor. (J.C.W.)

47704 MOMENTUM FLUX IN TWO-PHASE FLOW. Prins, C. A. (Delft Technological Univ., Netherlands). J. Heat Transfer, 91: 454-5(Aug. 1969).

The effectiveness of several two-phase flow models in predicting the momentum flux was investigated. It was found that none of the models incorporating slip between the two phases agreed with experimental data. It was not realistic to conclude that no slip occurs. It was concluded that the discrepancy between the momentum flux predicted by the slipflow models and the actually measured values is due to the unsteady nature of the flow at low qualities and to peaking to the velocity profiles at high (greater than 20%) qualities. The effect that is not accounted for in the aforementioned model is virtual mass of the gas bubbles, which can be explained by considering a bubble moving with a velocity different from the surrounding liquid (slip flow). A mathematical model with the virtual mass effect is discussed. (J.C.W.)

47705 MASS-TRANSFER MODEL IN SUBCOOLED NUCLEATE BOILING. Snyder, N. W. (Georgia Inst. of Tech., Atlanta); Robin, T. T. J. Heat Transfer, 91: 404-12(Aug. 1969).

The mass-transfer model of subcooled boiling is reviewed. An experiment is described in which a water vapor bubble was studied from its growth on a heated surface, through a thermal layer, and into a turbulent stream of subcooled water flowing parallel to the heated surface. The effectiveness of the turbulent subcooled stream in removing heat deposited by condensation on the surface of the bubble was determined. The results show that the thermal-energy transport associated with the mass-transfer mechanism in boiling heat transfer can be absorbed effectively at the top of the bubble. Also given are the results of a theoretical investigation in which two models of bubble dynamics were derived. The first model describes the artificial bubble produced in the experiment just noted. The second model describes the dynamics of a bubble growing on a heated surface, into a subcooled liquid, and with an evaporating thin liquid film below the bubble on the heated surface. The results show that the importance of the mass-transfer mechanism has been underestimated in the past and that this mechanism is responsible for a substantial portion, or almost all, of the heat transfer in subcooled nucleate boiling in forced convection. (auth)

47706 MECHANISM OF AND STABILITY CRITERION FOR NUCLEATE POOL BOILING OF SODIUM. Shai, I.; Rohsenow, W. M. (Massachusetts Inst. of Tech., Cambridge). J. Heat Transfer, 91: 315-29(Aug. 1969).

Experimental data for sodium boiling on horizontal surfaces containing artificial cavities at heat fluxes of 20,000 to 300,000 Btu/ft^2 hr and pressures between 40 to 106 mm Hg were obtained. Observations were made for stable boiling, unstable boiling, and bumping. Some recorded temperature variations in the solid close to the nucleating cavity are presented. It is suggested that for liquid metals the time for bubble growth and departure is a very small fraction of the total bubble cycle, hence the delay time during which a thermal layer grows is the most significant part of the process. On this basis the transient conduction heat transfer was solved for a periodic process, and the period time was found to be a function of the degree of superheat, the heat flux, and the liquid thermal properties. A simplified model for stability of nucleate pool boiling of liquid metals is postulated from which the minimum heat flux for stable boiling can be found as a function of liquid-solid properties, liquid pressure, the degree of superheat, and the cavity radius and depth. At relatively low heat fluxes, convection currents have significant effects on the period time of bubble formation. An empirical correlation is proposed, which

takes into account the convection effects, to match the experimental results. (auth)

47707 HEAT EXCHANGE TUBES. Fraser, Thomas McIntosh (to Courtaulds Ltd.). British Patent 1,161,612. Aug. 13, 1969. Filed Nov. 24, 1965.

The heat exchanger tube system described was designed for use in the vapor compression process for the desalination of sea water (see also British Patent 1,139,810), and may be useful in other heat exchanger systems employing bundles of parallel tubes. The system comprises a bundle of parallel heat exchange tubes mounted between tube plates; the tubes are fabricated of flexible thermoplastic film and have outwardly extending projections. These projections may comprise ribs extending along the length of the tubes, and each tube may have two sets of ribs running in opposite helices along the length of the tube. The projections may also comprise "pimples" distributed along the length of the tubes, and the "pimples" may be distributed helically. A method for forming the "pimples" and corresponding "dimples" is described. The projections function as spacing elements, and alleviate sagging. (UK)

47708 TRANSIENT THERMAL CHARACTERISTICS OF UO_2 FUEL RODS. Nagai, Masayuki; Kawai, Toshio; Hori, Masae (Hitachi Central Research Lab., Ozenji, Japan). J. Nucl. Sci. Technol. (Tokyo), 6: 494-7(Sept, 1969).

Transient characteristics of average temperature and heat flux of UO_2 fuel rods have been obtained with account taken of the effect of temperature dependence of thermal properties. The first order deviation of the temperature distribution inside the fuel rod is solved by modal expansion, and the coefficients and time constants obtained for the transfer functions. The results have been compared with those by the conventional method: the differences found as a result in the transfer functions for typical fuel rods are within 1 db in gain and 5 degrees in phase when the volume-averaged fuel temperature is used in the conventional method. (auth)

Isotope Technology

Refer also to abstracts 47662, 47664, 47689, 47701, 47815, 48315, 48389, and 48698.

47709 (AI-AEC-12841) LARGE RADIOISOTOPE HEAT SOURCE CAPSULE PROGRAM. TOPICAL REPORT NO. 7. CAPSULE FIRE TEST RESULTS. Harris, J. M. (Atomics International, Canoga Park, Calif.). May 29, 1969. Contract AT-(29-2)-2338. 54p. Dep. CFSTI.

A test was performed to establish the behavior of the refractory metal Large Radioisotope Heat Source Capsule in the flame of a solid propellant, such as might be encountered in the event of a launch pad abort. An instrumented capsule was placed on top of a block of Algol IIB solid propellant. The propellant burned in ambient air for approximately 10 minutes, four minutes at a heat flux of 38 BTU/ft^2/sec and thereafter at a reduced heat flux. Within one minute after propellant ignition the platinum oxidation cladding reached its melting point, exposing the tantalum alloy structural shell directly to the propellant flame and ashes. There was attack to the surface of the capsule by interstitial elements in the flame and air, and erosion from the molten platinum, rhodium, and aluminum. However, the structural shell was not breached and the fuel simulant was completely contained. The test established that the LRHS capsule can withstand the potentially severe environment of a launch pad abort fire, remain impermeable to helium and completely contain a radioisotope fuel. (auth)

47710 (BARC-395) ABSOLUTE STANDARDIZATION OF ^{60}Co AT BARC FOR INTERNATIONAL INTERCOMPARISON. Srivastava, P. K.; Khera, G. D. (Bhabha Atomic Research Centre, Bombay (India)). 1969. 31p. Dep. CFSTI (U. S. Sales Only).

Absolute standardization of cobalt-60 is of great importance for the precision measurements of radioactivity because due to its nearly ideal decay scheme, this radionuclide is amenable to standardization with the highest accuracy. International intercomparison of the dilution and source preparation was, therefore, organized by the Bureau International des Poids et Mesures, France, using the radionuclide ^{60}Co. The technique employed at the Bhabha Atomic Research Center for the absolute standardization of ^{60}Co for this intercomparison is described. This technique offers high accuracy, precision and reliability and, with minor modifications, is widely applicable to many radionuclides of interest. The gravimetric methods of dilution and source preparation are discussed briefly. The various parameters of the counting method are described. Finally, some details are given of the processing and evaluation of the counting data on the TIFR computer CDC-3600; the results of measurements together with their errors are also included. The results show that this technique yields a precision of about 0.1 percent, which is just about the highest achieved with the present state of development. (auth)

47711 (MMM-3691-52) SNAP-21 PROGRAM, PHASE II. DEEP SEA RADIOISOTOPE-FUELED THERMOELECTRIC GENERATOR POWER SUPPLY SYSTEM. Quarterly Report No. 12, April 1-June 30, 1969. (Minnesota Mining and Mfg. Co., St. Paul. Electrical Products Group). Contract AT(30-1)-3691. 186p. Dep. CFSTI.

Fueled system performance predictions were completed for systems S1OP1, S1OP2, and S1OP3. Dynamic testing and standard reference performance tests were completed on S1OP4. The biological shield which was removed from the insulation system B1ODL1 was incorporated into the insulation system B1ODL8. The insulation system B10D2 was leak checked and thermally tested. The radiation shield, spider, spider bolt, and inner liner from insulation system B1ODL3 were shipped. Thermal performance testing was conducted on insulation units B1ODL7 and B1ODL8. The insulation system B1ODL6 was mated with generator A1OP1 for long-term testing. Testing continued on Phases I and II thermoelectric generators and power conditioners. A conceptual design effort was started on the 20-watt system. (J.C.W.)

47712 (NP-18012) STABLE ISOTOPES: SALES AND LOANS OF ISOTOPIC SAMPLES, NUCLEAR TARGETS, ISOTOPIC FOILS, [AND] MOESSBAUER ADSORBERS. (Atomic Energy Research Establishment, Harwell (England)). 1968. 28p. Dep. CFSTI (U. S. Sales Only).

The elements and isotopes stocked and their chemical form, abundance, and price are listed. Also, information on the targets which can be supplied are listed, including preparation method, weight limit, chemical form, and type of backing. The AERE loan service for isotope samples and certain targets is described. (W.H.K.)

47713 (STI/PUB-202) RADIOISOTOPES IN THE PULP AND PAPER INDUSTRY. Panel Proceedings Series. Report of a Panel Held in Helsinki, October 9-13, 1967. (International Atomic Energy Agency, Vienna (Austria)). Aug. 1968. 117p. (CONF-671083). IAEA $3.50.

Information is included on: radioisotopic instruments, their uses in the U. S. paper industry, and the development and use of basic weight gages; the use of radioactive tracers for measuring flow rates in water, process liquids, and pulp, for determining process plant kinetics, and for estimating the degree of environmental pollution caused by the release to surrounding air and water of paper industry waste effluents; experience with radioisotopic static eliminators; and current research on wood-plastic combinations using irradiation. (L.C.L.)

47714 (TID-25137) STUDIES OF THE MEASUREMENT OF SULFUR DIOXIDE IN STACK GASES. Three Concurrent Studies. (Industrial Nucleonics Corp., Columbus, Ohio. International Chemical and Nuclear Corp., Pittsburgh, Pa. Nuclear Science Div. Texas Nuclear Corp., Austin). Jan. 29, 1968. Contracts AT(30-1)-3882; AT(30-1)-3881; AT(30-1)-3880. 315p. Dep. CFSTI.

A ^{109}Cd photon emitter was developed for use in the x-ray absorption method for determining sulfur dioxide in stack gases. The technique involves exchanging high-atomic-number mercury (from mercurous chloride) for a low-atomic-number sulfur (in sulfur dioxide) in a small reaction cell. The water-soluble bisulfitomercurate ions are passed through a filter into a measurement cell. There the concentration is automatically measured using the small ^{109}Cd source. (M.C.G.)

47715 GAS CENTRIFUGE PROJECT. Barnaby, C. F. Sci. J., 5A: 54-9(Aug. 1969).

The Netherlands, United Kingdom, and West Germany are cosponsoring the building of gas centrifuge plants for the enrichment of uranium for reactor fuels. Possible implications of this tripartite scheme in relation to nuclear weapons control are discussed. The technology of uranium enrichment and the economics of the use of gas centrifuges are briefly described. (G.M.C.)

47716 RADIATION SOURCE FOR ION GENERATORS. Asahina, Jiro. Japanese Patent 1969-12987. June 11, 1969. Filed Oct. 8, 1964.

The radiation sources proposed are used in an ion generator, which, in connection with ventilation, ionizes incoming air for health purpose. Such sources in the form of fins are attached to the inner surface of a cylinder with a fan. The method has the following advantages: long integrity of the shape of radiation sources, despite such accidents as fire and earthquake; prevention of the scattering of radioactive particles into the air, and considerable increase in the safety of the ion generator. A ra-

dioactive substance, which emits weak radiation such as alpha- or beta, is mixed in the base resin-material through which the radiation penetrates. (NSA of Japan)

Materials Testing

Refer also to abstracts 47709, 47872, 48315, 48352, and 48457.

47717 (ORNL–4420, pp 188–97) NONDESTRUCTIVE TEST DEVELOPMENT. Harms, W. O.; McClung, R. W. (Oak Ridge National Lab., Tenn.).

Development of new techniques and equipment for the nondestructive testing of materials and components are reported. The major emphasis has been on eddy-current, ultrasonic, penetrating radiation, and holographic methods. In analytical work on electromagnetic phenomena, continued use of closed-form solutions to integral equations applicable to a variety of eddy-current tests has been practiced. This work has been directed toward determining optimum coil designs for detecting flaws in tubing. Transparent plastic models of butt welds containing simulated flaws have been made for use in a schlieren system. A computer program to calculate x-ray mass-absorption coefficients for Al and U_3O_8 in a fuel plate was developed. Work is in progress for use of radiation scattering for measuring the thickness of cladding. (auth)

47718 COMPUTERIZED INFORMATION RETRIEVAL FOR NONDESTRUCTIVE TESTERS: A NONDESTRUCTIVE MEMORY. Bridges, W. H.; McClung, R. W. (Oak Ridge National Lab., Tenn.). Mater. Eval., 27: 199–204(Sept. 1969).

About two years ago, an Information Center was formed at the Oak Ridge National Laboratory to store and allow systematic retrieval of the rapidly growing literature on the subject of Nuclear Fuel Technology. Such a subject is very broad, encompassing materials, methods, management, economics, operational characteristics, and testing. Since all methods of nondestructive testing (NDT) are, or may be, applicable to the technology, much of the NDT literature is within the scope of the Information Center. Bibliographic information and abstracts entered into a large computer together with appropriate keywords may be manipulated to recall anything from very general bibliographies to information on a very specific question. The types of retrieval and experience with the computerized information system are discussed. (auth)

47719 A CORRELATION OF NONDESTRUCTIVE TESTING WITH DESTRUCTIVE TESTING OF ZIRCALOY-STEEL WELDED JOINTS FOR REACTOR PRESSURE TUBES. Albertini, C.; Jung, J.; Montagnani, M.; Verzeletti, G. (EURATOM–CCR, Ispra, Italy). Mater. Eval., 27: 185–92(Sept. 1969).

Coextrusion, swaging, and explosion-welded Zircaloy-steel tube joints were tested with an ultrasonic through-transmission technique which gave a map of welded zones with varying degrees of bonded and unbonded areas. These results were checked with destructive testing (tensile testing and microscopic examination) in order to establish a correlation, if possible. Microscopic examination showed a good agreement with ultrasonic data. On the coextruded and swaged joints, the ultrasonically bonded zones gave values of mechanical strength varying in a wide range due to the presence of intermetallic bonds; on explosive welded joints, constant values of mechanical strength were obtained in good agreement with ultrasonic testing. (auth)

47720 STRESS-WAVE EMISSION IN NDT. Pollock, A. A. Non-Destruct. Test., 2: 178–82(Aug. 1969).

Acoustic emission (or "stress-wave emission") is one of the most promising new techniques of non-destructive testing. It is currently in use in the aerospace and nuclear industries for monitoring the growth of cracks and flaws in pressure vessels. It is particularly useful for locating flaws which may be tens of feet from the detecting transducer. Failure strength prediction and metal condition diagnosis can be carried out by use of acoustic emission. It can also be used to predict the failure strength of adhesive bonds and to detect poor adhesion. (auth) (UK)

Protective Structures

Refer also to abstract 48958.

Radioactive Material Handling

Refer also to abstracts 47648, 47671, 47672, and 48353.

47721 (GAMD–9272) INTERIM STORAGE OF SPENT HTGR FUEL. Shefcik, J. J. (Gulf General Atomic, Inc., San Diego, Calif.). Apr. 15, 1969. Contract AT(04-3)-167. 15p. Dep. CFSTI.

Uncertainties in the projected growth of an HTGR economy and in the timing of an HTGR fuel reprocessing plant startup and difficulties in operating a very large interim storage facility make it unfeasible to consider only a single interim storage unit. Building multiple storage units on one or more sites as the need for the individual unit becomes apparent is suggested. Storage units each capable of holding the spent fuel from three 1000-MW(e) HTGR cores were judged to be a reasonable size. The spent HTGR fuel is sealed in four-element containers for shipment and may be stored either in air or under water. Since the HTGR fuel particles can react with water, special precautions are needed with underwater storage for the detection, isolation, and repair of containers that develop leaks. The first interim storage unit built on a site must include many ancillary facilities and is, therefore, more expensive than additional units later built at the same site. The estimated interim storage facility capital and operating costs are given. Conceptual designs are included. (auth)

47722 (IDO–22051) BEHAVIOR OF ^{133}Xe GAS AFTER INJECTION UNDERGROUND: MOLECULAR DIFFUSION, MATERIALS BALANCE, AND BAROMETRIC PRESSURE EFFECTS. Robertson, J. B. (Geological Survey, Idaho Falls, Idaho, Water Resources Div.). July 1969. 37p. Dep. CFSTI.

Nine hundred eighty-seven curies (Ci) of radioactive ^{133}Xe gas were injected rapidly under pressures of 1.5 to 1.65 psig with one million cubic feet of air into permeable basalt strata at the National Reactor Testing Station, Idaho. A capping layer of semipermeable fine-grained playa sediments confined the gas underground. The subsurface ^{133}Xe was monitored by Geiger–Mueller detectors and by air samples from observation wells surrounding the injection well. Underground distribution patterns after injection pressures had dissipated were evaluated by materials-balance analyses. The results indicated that most of the ^{133}Xe remained underground and decayed radioactively, and that the underground air-sample analysis data were erroneously low by a factor of approximately 10. Molecular diffusion rates of ^{133}Xe from the ground were estimated using a simplified numerical model. A maximum flux rate of 2,560 μCi/hr from a ground-atmosphere interface of 2.88×10^6 ft^2 was calculated for the first day after injection. The estimated rates indicated a total diffusion loss of 0.37 Ci for the total area during the 26-day observation period. The calculated rates had fairly good agreement with the measured, very low flux rates at the ground surface. Erratic variations in the flux rates measured by Texas Instruments, Inc., and Isotopes, A Teledyne Company, were attributed to other influences such as barometric pressure changes. The effects of barometric pressure on the vertical flow rates of ^{133}Xe were estimated for the maximum possible conditions. Theoretically, a maximum pressure differential of 0.40 inch of mercury across 10 feet of playa sediments could induce an air flow of 65 ft^3/ft^2/day in the small zone where the sediment cover is thinnest (about seven feet) and ^{133}Xe concentrations were highest. Average rates over the whole test area should have been much lower because of thicker sediments (average of 43 feet) and lower concentrations; however, they could have been comparable in magnitude to the molecular diffusion rates. It was concluded that molecular diffusion and barometric effects could produce the flux rates measured; however, the rates were too low to remove a significant portion of the 987 Ci of ^{133}Xe, nearly all of which remained underground and decayed, radioactively. Although they are only approximate, the general methods and techniques used for the diffusion, materials balance, and barometric analyses were generally satisfactory and could be applied to future underground gas-injection problems. (auth)

47723 (IN–1278) DEVELOPMENT OF IN-BED COMBUSTION HEATING FOR CALCINATION OF RADIOACTIVE WASTES. Thompson, T. K. (Idaho Nuclear Corp., Idaho Falls). July 1969. Contract AT(10-1)-1230. 25p. Dep. CFSTI.

In-bed combustion, the burning of a hydrocarbon fuel directly in a fluidized bed, was investigated as a method of supplying heat for fluidized-bed calcination of radioactive liquid wastes in the Waste Calcining Facility at the Idaho Chemical Processing Plant. Direct combustion of a fuel within the fluidized bed has the inherent advantage of eliminating the high metal temperatures experienced in the present circulating NaK system; the majority of the unscheduled shutdowns have resulted from metallurgical failures of the liquid metal heat transfer system. Pilot-plant studies on the calcination of synthetic aluminum and zirconium wastes by in-bed combustion in a twelve-inch calciner have demonstrated: that calcined solids formed during in-bed combustion and by indirect heating have similar properties; the potential for decreased air pollution as a result of the formation of small quantities of nitrogen oxides; the

potential for increased capacity for an existing calciner; and that operation of a calciner using in-bed combustion is safe. Results from development studies indicated that in-bed combustion can be employed advantageously in the existing Waste Calcining Facility. (auth)

47724 (JAERI–4049) ENGINEERING DRAWINGS FOR RADIOACTIVE WASTE TREATMENT FACILITIES IN TOKAI RESEARCH ESTABLISHMENT, JAERI. Hirayama, Katsuyoshi (ed.) (Japan Atomic Energy Research Inst., Tokai. Tokai Research Establishment). Feb. 1969. 61p. (In Japanese). Dep. CFSTI (U. S. Sales Only).

Engineering drawings are given for the main facilities and equipment for treatment and disposal of radioactive wastes in the Tokai Research Establishment, JAERI. Also, operation and maintenance of the equipment is described. The facilities and equipment are those constructed, altered, or moved from one place to another, for the period of JAERI establishment to January 1969. (auth)

47725 (NP–17955) NATIONAL COMMISSION ON NUCLEAR ENERGY. Tacar, Pulat (Atomic Energy Commission, Ankara (Turkey)). 1969. 134p. (In Turkish). Dep.

After a brief introduction to production and enrichment processes for uranium and plutonium, the subject of control is introduced by discussing methods of sealing, inspection, tracing and sampling. The control system instituted by the International Atomic Energy Agency is discussed in detail. The items to be controlled are clarified, and the points at which control starts and ends are spelled out. The selection, appointment, and dispatching of inspectors are discussed. Control of nuclear materials by the European Nuclear Energy Agency (ENEA) is discussed in a separate section. The methods of inspection and legal implications are considered. Documents for the IAEA control system (Information Circ/66/1) are appended. Copies of the IAEA inspector's report, and a Turkish deposition on the subject of nuclear energy control are also presented. (TTT)

47726 (ORNL–TM–2293) STRUCTURAL ANALYSIS OF THE BROOKHAVEN NATIONAL LABORATORY PORTABLE CESIUM IRRADIATOR. Evans, J. H. (Oak Ridge National Lab., Tenn.). Sept. 1969. Contract W-7405-eng-26. 56p. Dep. CFSTI.

An analytical evaluation of the Brookhaven National Laboratory Portable Cesium Irradiator was made to demonstrate its compliance with regulations governing packages in which radioactive material is shipped. Computational procedures and testing and operating experience were used to determine the structural integrity and thermal behavior of the irradiator with respect to the general standards for packaging, the structural standards, standards for normal conditions of transport, and the standards for the hypothetical accident conditions. This analysis demonstrated that with the proposed crash frame, puncture plates, and the other minor modifications, the irradiator complies with all the applicable regulations. (auth)

47727 (STI/DOC–10/78) OPERATION AND CONTROL OF ION-EXCHANGE PROCESSES FOR TREATMENT OF RADIOACTIVE WASTES. Technical Reports Series No. 78. (International Atomic Energy Agency, Vienna (Austria)). 1967. 147p. IAEA $3.00. Dep.

A manual dealing with the application of ion-exchange materials to the treatment of radioactive wastes is presented. Included is background material on radioactive wastes, removal of radioactivity, principles of ion exchange, ion-exchange materials, the limitations of ion exchangers, application of ion exchange to waste processing, operational procedures and experiences, and the costs of ion exchange waste treatment. Existing facilities currently using this method are described. (auth)

47728 CONTAINER FOR RADIOACTIVE FUEL ELEMENTS. Schilies, Adolph P. (to United States Atomic Energy Commission). U. S. Patent 3,466,445. Sept. 9, 1969.

A container for holding or transporting nuclear reactor fuel elements is described. It consists of a stack of neutron absorbing members having matching longitudinal grooves forming passageways in which the fuel elements may be separately supported, and a housing surrounding and confining the stack having means for engagement of a remotely operated handling device. (auth)

INSTRUMENTATION

Radiation Detection Instruments

General Detectors and Monitors

Refer also to abstracts 47703, 47875, 47913, 48045, 48051, 48766, and 49259.

47729 (AD-689733) PROTOTYPE COINCIDENCE NEUTRON COUNTER FOR INTERNATIONAL SAFEGUARDS AND ARMS CONTROL APPLICATIONS. Omohundro, R. J.; Marchetti, F. A. (Naval Research Lab., Washington, D. C.). June 1969. 23p. (NRL-MR-2005). CFSTI.

A neutron coincidence detector has been developed which can distinguish between neutrons occurring as a result of fission and those due to (α,n) or (γ,n) type reactions. Recent tests indicate that the instrument can also be used to predict the isotopic content of certain types of plutonium samples. (USGRDR) (auth)

47730 (ANL-7545) THICKNESS CORRECTIONS FOR NEUTRON-ACTIVATED GOLD FOILS. Stanford, George S.; Seckinger, James H. (Argonne National Lab., Ill.). Feb. 1969. Contract W-31-109-eng-38. 78p. Dep. CFSTI.

Thesis. Submitted by James H. Seckinger to Vanderbilt Univ., Nashville, Tenn.

Curves for determining thickness-correction factors for treating counting data for sets of neutron-activated, unmatched gold foils have been determined experimentally, by using the first derivative of the curve of activation versus thickness. This was done for both epithermal and thermal activation of gold foils irradiated in a near-isotropic flux in a void in a graphite thermal column. The epithermal activation agreed well with a published theoretical calculation. To obtain a differentiable curve from the activation data, a computer code was written to perform a least-squares fitting process to obtain the coefficients C_i for the equation $A(t) = C_1 + C_2 f(t) + C_3 f^2(t) + C_4 f^3(t)$, where A(t) is the specific activation of a foil of thickness t, and f(t) is a differentiable function with a theoretical basis for being at least an approximate fit to the data. For the epithermal data, the calculated self-shielding function for a single-resonance approximation was used for f(t). For the thermal case, f(t) was taken to be the standard thermal self-shielding function. One advantage of this approach over fitting to an arbitrary function, such as a polynomial or sum of exponentials, is that we can extrapolate to zero thickness with greater assurance. (auth)

47731 (BNWL-1096) INTERCALIBRATION OF COUNTING LABORATORIES. Ulseth, J. A. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Aug. 1969. Contract AT(45-1)-1830. 8p. Dep. CFSTI.

Eleven major radioisotope counting laboratories have participated in an intercalibration test to determine the degree of consistency among the laboratories in measuring activations from the $^{54}Fe(n,p)^{54}Mn$, $^{46}Ti(n,p)^{46}Sc$, $^{58}Ni(n,p)^{58}Co$, and $^{59}Co(n,\gamma)^{60}Co$ reactions. The counting results of this test compare favorably with a similar test conducted in 1963 with the exception of results for the $^{58}Ni(n,p)^{58}Co$ reaction where the standard deviation (1σ) among laboratories has slipped from ±2.6% to ±4.2%. The laboratories were also asked to calculate fast (E > 1 MeV) and thermal fluence values from the activities. In determining fluence from these monitors, the laboratories were consistent only for thermal fluence (standard deviation of 8%). Fast fluence determined from the threshold monitors differ by as much as ±23% for the $^{54}Fe(n,p)^{54}Mn$ reaction, to ~±15% for the $^{58}Ni(n,p)^{58}Co$ and the $^{46}Ti(n,p)^{46}Sc$ reactions. (auth)

47732 (COO-1671-18) FORMATION OF PARTICLE TRACKS. Katz, Robert; Kobetich, E. J. (Nebraska Univ., Lincoln. Behlen Lab. of Physics). Feb. 24, 1969. 19p. (CONF-690522-4). Dep. CFSTI.

From International Meeting on the Study of Charged Particle Tracks in Solid Insulators and Their Application, Clermont-Ferrand, France.

The formation of particle tracks, and such phenomena as the detection of charged particles and the damage produced by charged particles, are intimately related to the spatial distribution of ionization energy deposited by delta rays. Changes in the spectrum of delta rays with the velocity of the primary particle imply that linear measures of the interaction of the primary particle with the medium, such as specific energy loss, or primary ionization, are unsatisfactory measures of effects produced in the medium, for they contain no knowledge of the spatial deposition of the lost energy. (auth)

47733 (KFK-845, pp 4.1-10) APPLICATION OF THE QUANTIMET TO THE EVALUATION OF AUTORADIOGRAMS. Hinrichsen, K. (Tuebingen Univ. (West Germany). Anatomisches Institut). (In German).

A quantitative evaluation of autoradiograms requires the objective counting of silver grains in the photoemulsion. The use of the counting function of a quantitative television microscope is possible up to silver grain densities of 35/10 μm^2. The apparatus and preparation difficulties arising in systematic use of the instrument are indicated. The measurement function of the device makes possible, under given preparation conditions, a detection of surface fraction of various object structures prerequisite for the determination of silver grain density. (tr-auth)

47734 (NYO-2740-6, pp 6-31) GAS MULTIPLICATION CHAMBERS FOR RADIATION MEASUREMENTS. Bengtsson, L. G.; Goodman, L. J.; Rossi, H. H. (Columbia Univ., New York. Radiological Research Lab.).

Gas multiplication in air-filled ionization chambers; multiplication uncertainties including high voltage, electrometer, background radiation, signal transmission lead, and chamber uncertainties; effects of air contamination on multiplication in tissue equivalent gas; multiplication in the ¼ inch spherical gas flow counter; and instrumentation are discussed. (W.H.K.)

47735 (NYO-2740-6, pp 108-12) TISSUE-EQUIVALENT COUNTER AND GAS FLOW SYSTEM. Srdoc, D.; Dicello, J. F. (Columbia Univ., New York. Radiological Research Lab.).

A tissue-equivalent spherical proportional counter without a grid is described. The gas flow system for the proportional counter in which the gas pressure is constant is also discussed. A brief description is included on the FET preamplifier. (B.G.D.)

47736 (NYO-2740-6, pp 113-30) WALL-LESS PROPORTIONAL COUNTERS. Gross, W.; Biavati, B. J.; Rossi, H. H. (Columbia Univ., New York. Radiological Research Lab.).

Tests were conducted to determine the operating conditions of wall-less proportional counters. The tests conducted included shape determination, counter resolution, and boundary diffuseness studies. Event spectra with a ^{241}Am alpha source were obtained for tissue spheres of several different sizes. (B.G.D.)

47737 (NYO-2740-6, pp 136-42) MEASUREMENT OF W (ENERGY PER ION PAIR) AT LOW PHOTON ENERGY IN VARIOUS GASES. Srdoc, D. (Columbia Univ., New York. Radiological Research Lab.).

The average pulse height versus photon energy is presented graphically for various gases using monoenergetic low-energy photon sources. Gases studied include a tissue-equivalent gas containing propane, a tissue-equivalent gas containing methane, propane, and a mixture of argon and methane. (W.H.K.)

47738 (NYO-2740-6, pp 199-206) BREAKDOWN PROTECTION CIRCUIT FOR PROPORTIONAL CHAMBERS. Bengtsson, L. G.; Goodman, L. J. (Columbia Univ., New York. Radiological Research Lab.).

Many ionization chambers and proportional counters are fabricated from tissue-equivalent plastic and use tissue-equivalent gas. In the event of a self-sustaining electric discharge (breakdown) in the gas or between parts of the chamber, the plastic, and possibly other materials in the chamber, can be severely damaged. Solid materials may also be deposited on the electrodes, thereby changing the operation characteristics of the chamber as a result of the induced alterations of the electrical field. Nontissue equivalent chambers are also subject to this hazard but generally to a lesser extent. It is thus highly desirable to use a device which protects the chamber from a prolonged breakdown. This device should work by quickly removing the high voltage across the chamber when a breakdown is indicated. However, a fast removal of the high voltage is equivalent to applying a large step signal which is capacitively coupled to the input of the electrometer. If the chamber capacitance is large relative to the input capacitance of the electrometer, a large fraction of the voltage step will appear at the electrometer input which would thus also require protection. Two separate devices have been developed for the two protection objectives, both utilizing magnetic reed switches. (auth)

47739 (UCLA-12-724, pp 35-42) BIOPHYSICS. (California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology).

Interim reports are presented for six studies conducted by the Biophysics group. The six studies include: Biophysical instrumentation and methodology – Physical cell measurements and separations and High speed sectioning scanner; Biophysical he-

matology and medical applications; Electron microscopy of cultured glial cells; Multielemental analysis of biological tissues; and Micro sample and single cell analysis. A list of publications for the current report period is also given. (E.R.B.)

47740 MEASURING THE THERMAL NEUTRON FLUX FROM THE SIMULTANEOUS ACTIVATION OF TWO DIFFERENT DETECTORS. Bak, M. A.; Romanov, Yu. F. At. Energ. (USSR), 26: 550-2(June 1969). (In Russian).

Measuring the neutron flux of a reactor usually requires the activation of two samples, one without cadmium and one covered with cadmium. It is shown, however, that two different materials can be irradiated, and the induced activities are a measure of the thermal neutron flux. This method avoids the introduction of cadmium with consequent danger of melting, lowering the reactivity of the reactor, and poor reproducibility of results. The method was experimentally verified by using gold and cobalt as the materials to be irradiated. The induced gold activity was measured by beta-gamma coincidence counting, and the induced cobalt activity by comparison with a cobalt standard. The value of the resulting flux was in good agreement with the neutron flux values obtained by irradiating gold and cobalt samples with and without a cadmium covering. The calculated cadmium ratios were also in good agreement with the directly measured values of the cadmium ratio. (TTT)

47741 STUDY OF SULFUR PELLET AS A DISASTER MONITORING PACK FOR TSING HUA FILM BADGE. Tsai, C. M.; Weng, P. S. (National Tsing Hua Univ., Hsinchu, Taiwan). Ho Tsu K'o Hsueh, 6: No. 3-4, 103-8(Apr. 1969).

The reaction $^{32}S(n,p)^{32}P$ was used as a disaster monitoring pack for Tsing Hua Film Badge. The fabrication of the sulfur pellet, the counting method, and the dose evaluation are described. An intercomparison of the experimental results was carried out between Tsing Hua and International Atomic Energy Agency and the comparison is in good agreement. (auth)

47742 SURFACE BARRIER TYPE SOLID STATE DETECTOR. Liu, Yuen-chung; Tzeng, Hu-hsin; Luo, Hann-hua; Chiang, Hsing-ho; Hou, Wen-sou; Lee, Chin-hsin (National Tsing Hua Univ., Hsinchu, Taiwan). Ho Tsu K'o Hsueh, 6: No. 3-4, 67-9 (Apr. 1969).

Fabrication of a surface barrier type solid state detector from a 100 Ω-cm n-type silicon crystal is described. The effective area is 70 mm^2 and the resolution is 130 keV for α particles produced by $^{27}Al(d,\alpha)^{25}Mg$ reactions at deuteron energy 2.25 MeV. (auth)

47743 COUNTING THE GAMMA RADIATION FROM A PLANE ISOTROPIC SOURCE WITH DETECTORS HAVING A NON-ISOTROPIC SENSITIVITY. Vorob'ev, V. A.; Nazarov, I. M.; Fridman, Sh. D. At. Energ. (USSR), 26: 555-6(June 1969). (In Russian).

The problem of counting radiation from a plane source is important in following radioactive fallout by surveying with an airplane. An expression is given for the readings at a height H as a function of the spectral-angular characteristics of the counter detector. It is noted that a detector with a conical collimator counts scattered gamma quanta from the entire hemisphere and not only from the plane. On analyzing the problem of an optimal detector collimator for measuring the activity of a plane source, it is found that the error increases with an increase in height H because of background radiation. If the angular distribution of the fallout and background gamma quanta is known, it is possible to select a detector collimator geometry which gives a minimum measurement error for a given detector at a given height. The contribution of scattered radiation from uranium, thorium, and potassium can be reduced to a minimum. At all measurement heights, oblique angles give more accurate results than are obtained with conical collimation and axial symmetry. Measurements at oblique angles are also more convenient in distinguishing between plane and volume sources. (TTT)

47744 SCINTILLATION ALUMINUM-PHOSPHATE GLASSES FOR REGISTERING GAMMA RADIATION. Syritskaya, Z. M.; Vlasova, M. A.; Kitaev, V. Ya. At. Energ. (USSR), 26: 557-8 (June 1969). (In Russian).

It was found that phosphate glasses were more satisfactory in scintillation efficiency than were silicate glasses, especially in the P_2O_5-Al_2O_3-CeO_3 system. The light yield as a function of composition was determined after excitation of the glass with ^{60}Co gamma quanta. A glass having a composition of 61 mol % P_2O_5, 16 mol % Al_2O_3 and 23 mol % CeO_3 was found to have a scintillation efficiency of 4 to 4.5% which decreased insignificantly with increasing thickness. The glass showed good transparency to its own light. The efficiency of counting ^{60}Co gamma radiation was 90 to 95% with respect to a NaI crystal of the same size under identical geometry conditions, which corresponded to a total absorption coefficient of about 0.17 per cm for ^{60}Co gamma quanta. (TTT)

47745 METHOD OF GAMMA-GAMMA ANGULAR CORRELATION MEASUREMENTS FOR SHORT LIFE NUCLEI. Hayashi, Takeo; Okano, Kotoyuki; Yuasa, Kazunori; Kawase, Yoichi; Uehara, Shinichi. Annu. Rep. Res. Reactor Inst., Kyoto Univ., 1: 162-70(Oct. 1968).

A multicounter goniometer for gamma-gamma angular correlation measurements was newly designed and constructed. It consists of 12 photomultipliers with NaI(Tl) crystals placed radially at intervals of 30° and a 12 × 12 coincidence matrix circuit which follows 12 linear amplifiers and 2 × 12 single channel pulse height analyzers. Coincidence counts at 11 angles between 30 and 330° are taken simultaneously for each of the 12 counters, so that with this method angular correlation measurements can be made within a time reduced by a factor 12 × 11, as compared with the ordinary method. (auth)

47746 MINIMUM IONIZATION PARTICLE DETECTOR PRODUCED BY GAMMA RAY IRRADIATION (Feb. 25, 1969) (Engineering Materials). (Princeton-Pennsylvania Accelerator, Princeton, N. J.). (CAPE-1919).

Minimum ionization particle detectors are produced by γ irradiation of Si disks in a box-shaped cell containing a ^{60}Co source of ~7 kCi strength. The Si disks are about 1.8 cm in dia with a resistivity of 1000 to 3000 ohm-cm. After irradiation, the disks have flat opposite sides; homogeneous, substantially-uniform crystal lattice defects; resistivity of at least 7×10^4 ohm-cm at 298°K and 15 V bias; and thin nickel contact films on the flat surfaces. The Si is biased during irradiation, and resistivity is measured during irradiation at 298°K to achieve maximum resistivity and minimum exposure. The detector can be used in high magnetic fields, at low temperatures, and to control counters at bubble chambers involving particles traveling at relativistic velocities, such as conversion electrons and μ-mesons. If the Si disks are left at room temperature for six months, no appreciable deterioration in detection ability is detected. (For details see TID-4100 Suppl. 55) (See NSA 23: 14005). (F.S.)

47747 DOSE RESPONSE OF COPPER AND PHOSPHOROUS ACTIVATION DETECTORS TO NEUTRON OF DIFFERENT SPECTORS. Obaturov, G. M.; Shishkin, G. V. At. Energ. (USSR), 27: 234-7(Sept. 1969). (In Russian).

The mean magnitudes of activation cross sections for thermal neutrons (with Maxwell distribution), intermediate neutrons (with Fermi spectra), and fast neutrons (with fission spectra) are, ordinarily, used for theoretical determination of mean fluxes and absorbtion doses of neutrons. However, neutron spectra near various reactors and critical assemblies vary significantly. In order to determine the possible magnitude of errors during measurements of doses for reactors and assemblies and obtain some additional data for calculating doses for series of apparatuses, calculations were made of the dose responses of copper and phosphorous detectors for 13 various spectra. Tabulated data are included in the mean dose sensitivity for activated ^{63}Cu and ^{31}P detectors to neutron spectra of fission, Godiva, HPRR, behind the shielding of B_4C, critical assembly with UO_2F_2 solution, heterogeneous reactor with H_2O moderator, uranium-graphite reactor, Vinca, behind the Pb, Fe, and C shieldings, BP-1, and spectra of ~1/E type. (R.V.J.)

47748 NEUTRON PERSONNEL DOSIMETRY BY RECORDING THE FISSION FRAGMENTS IN MICA FOILS. Stolz, W.; Doerschel, B. (Technische Hochschule, Dresden). Kernenergie, 12: 244-50 (July 1969). (In German).

A technique of separately determining the dose equivalent of thermal, intermediate, and fast neutrons by nonphotographical record of the fission fragments in a solid is described. The detailed investigation of various detector materials (mica, microscope cover glass, Yokota glass, cellulose acetate, Makrofol E) shows the most favorable properties for personnel neutron dosimetry to be possessed by the mica foils. Both natural and enriched uranium foils have been used as the fissile materials. The etched tracks of fission fragments are recorded either by visual counting of the tracks under microscope or by means of a photoelectric technique utilizing a sensitive photoresistance cell. Limits of the measuring range and dependence on direction of the dosimeter are discussed. The assembly consisting of combined fissile material and mica foils is suited for application in routine and emergency dosimetry. (auth)

47749 ABSOLUTE DETERMINATION OF NEUTRON SOURCE STRENGTH IN THE GERMAN BOARD FOR METROLOGY AND GOODS TESTING. PART I. ABSOLUTE DETERMINATION BY ACTIVATION OF GOLD FOILS. Hochhaeuser, E.; Rothe, H.; Schoenfeld, E. (Deutschen Amt fuer Messwesen und Warenprue-

fung, Berlin). Kernenergie, 12: 250-2(July 1969). (In German).

The normal techniques for determining absolutely the emission rate of radioactive neutron sources applied in the German Board for Metrology and Goods Testing of the G.D.R. are described. The first part deals with the method of geometric integration of the thermal neutron density in a water moderator surrounding the source by means of gold foils, the absolute decay rates of which are determined after activation by using a β-γ coincidence technique. After giving a detailed description of the activation equipment and the measuring process, all the corrections necessary for the source strength determination are considered in the light of standardizing a RaBe(α,n) source. With this technique the emission rate of the standardized source was found to be Q = (5.64 ± 0.15) × 10^6 s^{-1}. (auth)

47750 TIME RESOLUTION OF A PARTICLE-GAMMA COINCIDENCE CIRCUIT. Gorodetzky, S.; Armbruster, R.; Knipper, A.; Merdinger, J. C.; Schulz, N.; Wachtel, F. (Institut de Recherches Nucleaires, Strasbourg). Rev. Phys. Appl., 4: 225-6 (June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

Timing experiments with photomultipliers and silicon surface barrier detectors have been carried out. The influence on the time resolution of different factors (silicon resistivity of the solid state detector, bias voltage, etc.) has been studied. (auth)

47751 PRACTICAL METHOD OF NEUTRON-GAMMA DISCRIMINATION. Kahane, J.; Sene, R.; Delpierre, P.; Heyman, M. Rev. Phys. Appl., 4: 257-8(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

A simple and convenient method of neutron-gamma discrimination is achieved by a damped RCL circuit attached to a single photomultiplier dynode. 99.5% of the neutrons above 500 keV are detected while 99% of the gamma are rejected. (auth)

47752 DETECTION OF PHOTONEUTRONS WITH A LIQUID SCINTILLATOR LOADED WITH GADOLINIUM. Beil, H.; Bergere, R.; Veyssiere, A. (CEN, Saclay, France). Rev. Phys. Appl., 4: 249-50(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

The essential characteristics of a large, gadolinium-loaded (0.5% in weight), liquid scintillator for neutron detection, used in photonuclear work at Saclay, are described. Efficiencies of the order of 85% are obtainable thus making observations of photonuclear reactions of the type (γ,3n) or (γ,2n) possible. Reasonable agreement between theoretical and experimental time histories for neutron capture inside the detector exists. Total background is reduced to 6 × 10^{-3} count per 25 μs time gate. (auth)

47753 DETECTOR FOR FAST NEUTRONS WITH SMALL DEPENDENCE OF RESPONSE ON ENERGY. Leroy, J. L.; Huet, J. L.; Szabo, I.; Le Rigoleur, C.; Abramson, D. (CEN, Cadarache, France). Rev. Phys. Appl., 4: 251-2(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

This device, designed with the aim of performing absolute measurements of neutron fluxes, is basically made of polyethylene and two BF_3 counters, surrounded by a thick shield. Neutrons to be counted are fed at the center of the device by a collimator. The absolute efficiency around 0.3 and 2.7 MeV was measured as well as the shape of response curve between 0.1 and 4 MeV. (auth)

47754 TEMPERATURE DEPENDENCE OF SCINTILLATION LIGHT YIELD OF p-TERPHENYL, ANTHRACENE, AND NAPHTHALENE CRYSTALS EXCITED BY α- AND β-PARTICLES. Schiffer, Hans-Wilhelm (Univ., Goettingen, Ger.). Z. Phys., 227: 482-92(1969). (In German).

The temperature dependence of the integral scintillation light yield of p-terphenyl, anthracene, and naphthalene single crystals excited by α- and β-particles was investigated between T = 10°K and T = 293°K. The variation of the scintillation anisotropy of p-terphenyl with temperature was measured as well. With decreasing temperature the scintillation light of anthracene and naphthalene is found to be emitted faster. The integral light yield of p-terphenyl shows a pronounced maximum at T = 34°K which is caused by the delayed component only. The maximum is explained by triplet exciton trapping. (auth)

47755 IDENTIFICATION OF IONS OF Z ≤ 8 BY ASSOCIATION OF TWO SEMICONDUCTOR DETECTORS. Brun, C.; Galin, J.; Gatty, B.; Lefort, M.; Tarrago, X. (Institut de Physique Nucleaire, Orsay, France). Rev. Phys. Appl., 4: 107-8 (June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

When a silver target is bombarded by carbon or nitrogen ions, several nuclei of Z ≤ 8 are obtained in transfer reaction processes. A two solid-state detector telescope allows us to identify all the nuclei and to measure their energy. The process used for mass identification is based on range energy curves given by Northcliffe. Data registered on magnetic tapes are treated on a computer event by event. (auth)

47756 LARGE ELECTROMAGNETIC SHOWER DETECTOR WITH HIGH REJECTION FOR PIONS. Bollini, D.; Buhler-Broglin, A.; Dalpiaz, P.; Massam, T.; Navach, F.; Navarria, F. L.; Schneegans, M. A.; Zichichi, A. (CERN, Geneva. Univ., Bologna. Istituto Nazionale di Fisica Nucleare, Bologna. Centre de Recherches Nucleaires, Strasbourg). Rev. Phys. Appl., 4: 108-10(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

A large electromagnetic shower detector which consists of nine layers, each one made of lead, spark-chamber and scintillation counter, is described. The rejection power against pions is of 6 × 10^{-4}, the efficiency for electron detection varies from 68 to 80% and the energy resolution from 15 to 10% in the energy range 0.4 to 1.1 GeV. (auth)

47757 COINCIDENCE SPECTROMETER WITH SEVEN NaI COUNTERS. Gorodetzky, S.; Beck, F. A.; Engelstein, P.; Bryski, T.; Knipper, A. (Centre de Recherches Nucleaires, Strasbourg). Rev. Phys. Appl., 4: 103-4(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

A seven detector NaI(Tl) 3 in. × 3 in. multicounter has been built. It allows the simultaneous measurements of the corresponding sixteen values of the angular correlation function $W(\theta_1, \theta_2, \varphi)$ or the Litherland and Ferguson seven geometries. This apparatus has been successfully tested in the case of well known angular correlations in radioactive decays as well as in nuclear reactions. (auth)

47758 PROPERTIES OF A WIDE-GAP SPARK CHAMBER. Schmitt, F.; Gresser, J.; Metzger, G.; Riedinger, M.; Sutter, G. (Institut de Recherches Nucleaires, Strasbourg). Rev. Phys. Appl., 4: 309-10(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

Properties are given of wide gap spark chambers being used in the sparking mode (gap, 30 cm; diameter, 30 cm) and in the streamer mode (gap, 20 cm; diameter, 30 cm). (auth)

47759 DEMOUNTABLE SPARK CHAMBER WITH THIN FOILS. Savel, P.; Ligonniere, G.; Yuasa, T. (Institut de Physique Nucleaire, Orsay, France). Rev. Phys. Appl., 4: 311-12(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

For studying some non-coplanar nuclear reactions such as (α, αp) and (α, 2α) at intermediate energies, a demountable spark chamber was constructed which has thin Al foil electrodes. Its operation is controlled by the accelerator. Its design characteristics are discussed. (auth)

47760 ON-LINE OPERATION OF A DIGITIZED MICROSCOPE WITH TELECONTROL. Volmer, P.; Christophel, E.; Persigny, J.; Jacquot, C. (CRN, Strasbourg). Rev. Phys. Appl., 4: 328 (June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

A digitized microscope for measurements in nuclear emulsions on-line with a small process-control computer is described. (auth)

47761 NEUTRON SPECTROMETRY WITH THE AID OF VISUAL IONOGRAPHIC DETECTORS. Debeauvais, M.; Stein, R.; Remy, G.; Ralarosy, J.; Tripier, J. (Centre de Recherches Nucleaires, Strasbourg). Rev. Phys. Appl., 4: 259-60(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

A spectrometer for 0 to 20 MeV neutrons is made with the aid of visual solid detectors. The following reactions are used: fission reactions on natural and enriched uranium with and without

cadmium, neptunium and thorium targets, for 0 to 10 MeV neutrons; and (n, α) reactions on beryllium, carbon and oxygen targets, for 3 to 20 MeV neutrons. Makrofol and nitrocellulose are respectively used as detectors for fission and (n, α) reactions. (auth)

47762 USE OF GERMANIUM DETECTORS FOR CHARGED PARTICLES. Marcus, L.; Duhamel, G.; Langevin-Joliot, H. (Institut de Physique Nucleaire, Orsay, France). Rev. Phys. Appl., 4: 279-80(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

Lithium-drift germanium detectors have been used for 80 MeV deuterons, with energy resolution close to that of the beam. Using side-entry technique, trapping phenomena have been seen, similar to those observed with collimated gamma rays, which result in a peak shift. (auth)

47763 SEMICONDUCTOR DETECTORS WITH INTERNAL AMPLIFICATION FOR NUCLEAR RADIATION. Roubert, F.; Siffert, P.; Coche, A. (Centre de Recherches Nucleaires, Strasbourg). Rev. Phys. Appl., 4: 284-5(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

By geometric control of the surface field, internal amplification p-n junctions have been constructed. Their characteristics are analyzed. Multiplication factors exceeding 1000 have been observed. (auth)

47764 DEVELOPMENT OF A DETECTOR OF GERMANIUM COMPENSATED WITH LITHIUM. Gallmann, A.; Molinari, M. A. (Institut de Recherches Nucleaires, Strasbourg). Rev. Phys. Appl., 4: 285-6(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

Several Ge(Li) detectors were examined by using the gamma-ray scanning technique. A particular example is that of a single-open end detector, the performances of which have been substantially increased after cutting the bad region. In order to improve the photopeak-to-Compton ratio of coaxial detectors, a spark machine was used for removing the central p-type core. Two such cases are presented. (auth)

47765 DETECTOR OF FISSION AT LOW TEMPERATURE (77°K). Blons, J.; Dumazert, M.; Eggermann, C.; Fermandjian, J.; Pranal, Y. (CEN, Saclay, France). Rev. Phys. Appl., 4: 287-9(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

The neutron fission cross-section of ^{239}Pu has been measured with a new type of gas scintillator containing 1 g of fissile material at liquid nitrogen temperature. The measurement was carried out by the time-of-flight method using the Saclay Linac as a pulsed neutron source. The resolution obtained with this detector is compared with those of other measurements. (auth)

47766 ADJUSTMENT OF A GAS SCINTILLATOR WITH VERY LOW BACKGROUND. Paya, D.; Blons, J.; Fermandjian, J.; Fubini, A.; Pranal, Y. (CEN, Saclay, France). Rev. Phys. Appl., 4: 289-90(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

A large-volume gas scintillator is described in which, by means of coincidences between photomultipliers, it has been possible to significantly reduce the background. Such an arrangement is particularly suitable for the measurement of very small fission cross-sections. (auth)

47767 ANGER'S GAMMA-CAMERA, A NEW PRINCIPLE IN SCINTIGRAPHY. Spaventi, S. Srp. Arh. Celok. Lek., 96: 195-200(Oct. 1968). (In Russian).

The design and performance of an Anger's gamma detector are presented. Drawings of the collimator and the hexagonal distribution of the photomultipliers are included. (R.V.J.)

47768 DEVELOPMENT OF THICK-LAYERED NUCLEAR EMULSIONS BY DIFFERENT DEVELOPING SUBSTANCES. Baranova, L. G. Zh. Prikl. Mekh. Tekh. Fiz., 14: 183-5 (May-June 1969). (In Russian).

Different developers were studied for the development of irradiated thick-layered nuclear emulsions, and the results and conclusions are presented. (tr-auth)

47769 TWO POTENTIAL METHOD OF DEVELOPMENT OF NUCLEAR EMULSIONS. Kocherov, N. P.; Novikova, N. R.; Perfilov, N. A. Zh. Prikl. Mekh. Tekh. Fiz., 14: 186-93(May-June 1969). (In Russian).

The use of inorganic developers for thick-layered nuclear emulsions sensitive to particles with minimum ionization is studied. The properties of iron oxalate developer were studied including the rates of penetration and development, film structure, and swelling of photosensitive layers. The particle recording thresholds were studied, and the relation of sensitivity of emulsions to low ionization particles with the oxidation-reduction potential of the developer was studied. The two potential method of nuclear emulsion development is proposed and developed for processing emulsions of different thicknesses. (tr-auth)

47770 MONITORING OF INTERMEDIATE-ENERGY NEUTRONS. Dayashankar; Venkataraman, G. (Bhabha Atomic Research Center, Trombay, India). pp 47-51 of Radiation Protection Monitoring. Vienna, International Atomic Energy Agency, 1969.

From Regional Seminar for Asia and Far East on Radiation Protection Monitoring, Bombay, India. See STI/PUB-199; CONF-681203.

A method of monitoring thermal and intermediate-energy neutrons up to 300 keV by means of a cadmium-covered boron-trifluoride counter is described. The intermediate-energy spectrum is assumed to be of 1/E type from 0.3 eV to 10 keV, $1/E^{0.8}$ type from 10 keV to 100 keV and $1/E^{0.5}$ type from 100 keV to 300 keV. This instrument is (a) more portable, and (b) reasonably accurate, since the calibration factor in the present case is derived from an exact fit of the dose-equivalent values at various energies. Also, preliminary results obtained with a personnel monitoring device for intermediate-energy neutrons which consists of a cadmium-boron filter and a track recording plastic are discussed. For this device, the contribution due to the back-scattered spectrum from the body has also been taken into account. (auth)

47771 SPECIAL CHARACTERISTICS OF TISSUE-EQUIVALENT IONIZATION CHAMBERS AND SCINTILLATORS. Pychlau, P.-J. (Physikalisch-Technische Werkstaetten, Freiburg i. B.). pp 53-9 of Radiation Protection Monitoring. Vienna, International Atomic Energy Agency, 1969.

From Regional Seminar for Asia and Far East on Radiation Protection Monitoring, Bombay, India. See STI/PUB-199; CONF-681203.

The field of application for tissue-equivalent detectors and the composition of standard human tissue, tissue-equivalent plastics, gases, and scintillators are discussed, and examples of tissue-equivalent detectors are presented. (auth)

47772 PERSONNEL MONITORING SYSTEM FOR RADIATION ACCIDENTS. Gupta, B. L.; Singh, D.; Singh Nagpal, J. B.; Kerekatte, U. S.; Rajagopalan, R.; Nayyar, S. S. (Bhabha Atomic Research Centre, Trombay, India). pp 335-41 of Radiation Protection Monitoring. Vienna, International Atomic Energy Agency, 1969.

From Regional Seminar for Asia and Far East on Radiation Protection Monitoring, Bombay, India. See STI/PUB-199; CONF-681203.

A composite high-level radiation monitoring system has been developed for personnel monitoring in cases of criticality accidents and other high radiation exposure incidents. This system incorporates (1) a chemical threshold detector containing tetrachloroethylene overlayered with an aqueous solution of bromocresol purple dye which changes color at a threshold of 20 rad of cobalt-60 gamma exposure, (2) a lead-shielded silver activated phosphate glass for measuring gamma dose from 50 to 1000 rad, (3) a sulphur pellet for the estimation of fast-neutron dose down to one rad, (4) bare and cadmium-covered gold foils for the estimation of thermal-neutron dose, and (5) an indium foil for the immediate sorting out of persons subjected to high neutron exposures. This system is used in conjunction with a six-filter film badge which uses a Kodak Type-II film. This film is capable of measuring gamma doses up to 1000 rad. The performance characteristics of this system are discussed. (auth)

47773 INDIVIDUAL MONITORING AND CONDENSER IONIZATION CHAMBERS. Subrahmanian, G. (Bhabha Atomic Research Centre, Trombay, India). pp 361-9 of Radiation Protection Monitoring. Vienna, International Atomic Energy Agency, 1969.

From Regional Seminar for Asia and Far East on Radiation Protection Monitoring, Bombay, India. See STI/PUB-199; CONF-681203.

Objectives of an individual monitoring system are outlined, and the basic requirements of good individual monitors are discussed. The various systems and their useful ranges are also presented. The interpretation of the readings of a personnel monitor for different types of radiation is reviewed. The condenser ionization chamber as an individual monitoring system is described. Mention is also made of the characteristics of the chamber such as the

range, natural leakage and energy dependence. The factors to be considered in interpretation and accuracy of the readings of condenser chambers are enumerated. These include the calibration accuracy, effect of input capacitance and exposure rate dependence. (auth)

47774 ORGANIZATION, METHODS AND RESULTS OF PERSONNEL MONITORING IN THE FEDERAL REPUBLIC OF GERMANY. Wachsmann, F. (Institut fuer Strahlenschutz, Neuherberg, Ger.). pp 407-23 of Radiation Protection Monitoring. Vienna, International Atomic Energy Agency, 1969.

From Regional Seminar for Asia and Far East on Radiation Protection Monitoring, Bombay, India. See STI/PUB-199; CONF-681203.

The "First Radiation Protection Ordinance" in the Federal Republic of Germany prescribes continuous measurement of the doses of all personnel working with nuclear radiation, but a monitoring obligation does not yet exist for X-rays. Approximately 30,000 persons are, nevertheless, being monitored monthly with film dosimeters at present. These measurements are performed by six monitoring agencies recognized by the state. For measuring β^-, γ^- and X-rays, a badge with 5 filters, functioning on the filter-analytical principle, is used. This dose double film from Agfa-Gevaert allows doses to be ascertained within limits of approximately 30 mR to 1000 R. The advantage of this method is that with its help one can ascertain, besides the dose, the kind of radiation and the radiation energy, the radiation incidence direction, the kind of exposure, possible contamination with radioactive dust and so on. This knowledge is required for correct estimation of the radiation load of the monitored personnel and to avoid a radiation hazard in the future. The neutron badge designed for nuclear plants and accelerators contains, besides the dose-double film, a Kodak nuclear-track film for measurement of fast neutrons, a cadmium filter for measurement of thermal neutrons, an activation pack (S and Au) for measurement of higher neutron doses and a glass dosimeter as a long-term dosimeter for γ-radiation. The last mentioned are only evaluated in the event of catastrophes. For measuring the doses to hands, finger rings with dose-double films, or recently with thermoluminescence dosimeters with LiF, are used. These controls, which have already been performed for the last 18 years, fortunately show a decrease in the medium doses and in excessive doses generally. (auth)

47775 GENERAL REVIEW OF THE AIR MONITORING INSTRUMENTS USED AT THE BHABHA ATOMIC RESEARCH CENTRE. Thukral, S. P.; Singh, A. N.; Nair, N. B. (Bhabha Atomic Research Centre, Trombay, India). pp 451-8 of Radiation Protection Monitoring. Vienna, International Atomic Energy Agency, 1969.

From Regional Seminar for Asia and Far East on Radiation Protection Monitoring, Bombay, India. See STI/PUB-199; CONF-681203.

Various types of continuous air-monitoring instruments designed and used at the Bhabha Atomic Research Center are described. The two types of instruments used for continuous monitoring of the airborne particulate radioactivity are the fixed-filter monitor and the moving-filter monitor. The selection of a particular type of monitor for a given area is discussed in detail. The development of a slope-sensitive alarm is described. The feasibility of replacing the comparatively sophisticated moving-filter air monitor by the fixed-filter type moniter fitted with the slope sensitive alarm is discussed. A continuous monitor for iodine-131 in air, which is fitted with activated-charcoal-impregnated filter paper, is also described and a general analysis of the calibration procedure, accuracy and reliability of air monitors is presented. (auth)

47776 REVIEW OF VARIOUS SURVEY INSTRUMENTS LOCALLY DEVELOPED FOR RADIATION PROTECTION WORK. Gangadharan, P.; Murthy, B. K. S.; Sankaran, A.; Degwekar, V. H.; Risbud, V. H. (Bhabha Atomic Research Centre, Trombay, India). pp 459-64 of Radiation Protection Monitoring. Vienna, International Atomic Energy Agency, 1969.

From Regional Seminar for Asia and Far East on Radiation Protection Monitoring, Bombay, India. See STI/PUB-199; CONF-681203.

Various survey instruments developed in the Directorate of Radiation Protection for radiological protection surveys of medical and industrial institutions are described. These instruments include (a) survey meters: (i) ion-chamber and scintillation types for measuring X- and gamma-ray exposures, and (ii) proportional counter and scintillation types for measuring slow- and fast-neutron fluxes; and (b) an isotope calibrator for measuring the activity of gamma sources. Each of these instruments was developed to meet specified operational requirements, taking into consideration various factors such as climatic conditions, availability of components and range of intensities of radiation encountered during the survey. All the instruments discussed in this review are portable and battery powered. (auth)

47777 WIDE RANGE PORTABLE RADIATION SURVEY METER FOR EMERGENCY MONITORING. Gangadharan, P.; Bhave, D. G.; Gokarn, R. S.; Khadake, R. G. (Bhabha Atomic Research Centre, Trombay, India). pp 465-70 of Radiation Protection Monitoring. Vienna, International Atomic Energy Agency, 1969.

From Regional Seminar for Asia and Far East on Radiation Protection Monitoring, Bombay, India. See STI/PUB-199; CONF-681203.

A portable battery-operated radiation survey meter for monitoring a wide range of X- and gamma-ray exposure rates from 1 mR/h to 100 R/h is described. The instrument incorporates a halogen GM tube as the detector and a count-rate meter for indication. A transistorized dc–dc converter supplies the necessary high voltage to the GM counter. The instrument response has been made energy independent in the energy range 80 keV to 1.25 MeV. Further, the response is linear over the entire range of exposure rates. Suitable extension rods have been designed to provide sufficient separation between the probe and the meter in cases where remote monitoring is necessary because of high fields. (auth)

47778 DESIGN CONCEPTS OF A CENTRALIZED AUTOMATIC AIR MONITORING SYSTEM FOR A LARGE RADIOISOTOPE COMPLEX. Joshi, C. W.; Ingle, N. A.; Jathar, N. B. (Bhabha Atomic Research Centre, Trombay, India). pp 471-5 of Radiation Protection Monitoring. Vienna, International Atomic Energy Agency, 1969.

From Regional Seminar for Asia and Far East on Radiation Protection Monitoring, Bombay, India. See STI/PUB-199; CONF-681203.

In a large radioisotope complex it is necessary to monitor the activity levels of a large number of laboratory rooms for threshold as well as rate-of-rise alarm conditions. A system for monitoring 100 locations has been designed wherein each location has only a detector and its count-rate meter. The outputs from the CRM's are brought to a central monitoring room where the system is located. A scanner in the system scans all the inputs sequentially at a speed of six seconds per input. During the six seconds when an input is selected, the actual value of the input and the threshold and/or rate-of-rise alarm are recorded. The alarm levels can be changed by means of program boards. The information is printed out on a teleprinter in a format which is convenient to inspect and store. The output is also available on a paper tape which can be fed to a computer for operational analysis. An alarm condition in any one of the laboratory rooms is annuciated to draw the operator's attention. (auth)

47779 RELIABILITY OF INSTRUMENTS, EFFECTS OF CLIMATIC CONDITIONS AND CONDITIONS OF USE. Gangadharan, P. (Bhabha Atomic Research Centre, Trombay, India). pp 489-98 of Radiation Protection Monitoring. Vienna, International Atomic Energy Agency, 1969.

From Regional Seminar for Asia and Far East on Radiation Protection Monitoring, Bombay, India. See STI/PUB-199; CONF-681203.

Various factors that are to be considered in predicting the reliability of electronic instruments are reviewed. Theoretical aspects of reliability are briefly described. Practical methods such as reliability prediction, redundancy, debugging and maintainability to achieve high reliability are enumerated. Effects of temperature and humidity on electronic components in general are discussed. Adverse effects of climatic conditions on nuclear electronic instruments are described and means to overcome them are suggested. Finally, simple and inexpensive techniques are described to achieve high reliability. (auth)

47780 SOURCES OF INACCURACY IN RADIATION MONITORING INSTRUMENTS. Cowper, G. (Atomic Energy of Canada Ltd., Chalk River, Ont.). pp 499-511 of Radiation Protection Monitoring. Vienna, International Atomic Energy Agency, 1969.

From Regional Seminar for Asia and Far East on Radiation Protection Monitoring, Bombay, India. See STI/PUB-199; CONF-681203.

The accuracy of monitoring instruments will be affected by several factors, which include statistical errors in counting random events, the stability of individual components of the monitor, the effects of adverse environmental conditions, and errors in calibration procedures. It is the objective of sound instrument design to overcome those effects which introduce errors and to avoid the use of particularly sensitive techniques and components. At the same time, care must be taken not to overdesign an instrument beyond the requirements of the situation in hand or else the cost of radiation protection becomes excessive. The accuracy achieved

in the use of an instrument will also depend upon how difficult it is to use and maintain and the relative experience and knowledge of its users and repairers. Good design will avoid aggravating this difficulty and should be as simple as the task in hand will allow. Accuracy must be considered in conjunction with reliability, which, in many situations confronting a health physicist, is of greater importance. Instruments for critical measurements should not fail in an unsafe manner and simple checking facilities, not necessarily having high accuracy, should be readily available to users. These topics are discussed with reference to particular monitoring problems and the various means which have been developed to solve them. (auth)

47781 EXPERIENCE GAINED IN THE CALIBRATION AND MAINTENANCE OF RADIATION MEASURING INSTRUMENTS FOR RADIATION PROTECTION. Gangadharan, P.; Sankaran, A.; Pal, N. C.; Deokar, M. R. (Bhabha Atomic Research Centre, Trombay, India). pp 531-38 of Radiation Protection Monitoring. Vienna, International Atomic Energy Agency, 1969.

From Regional Seminar for Asia and Far East on Radiation Protection Monitoring, Bombay, India. See STI/PUB-199; CONF-681203.

Various techniques employed in the calibration and maintenance of instruments used for routine measurements in radiation protection, such as radiation survey meters (both ion-chamber and GM types) and instruments incorporating electrometers (quadrant and valve types) are described. Emphasis is placed on faults commonly encountered, such as humidity effects and surface resin formation and the various procedures for rectifying them. The minimal test equipment essential for routine maintenance of the above instruments is also discussed. Steps to be taken for the preventive maintenance of different parts of the instruments are enumerated. Various errors which may occur during testing and calibration are cited and methods to eliminate these errors are suggested. (auth)

47782 PRACTICAL SOLUTIONS TO THE PROBLEM OF INSTRUMENT CALIBRATION. Pychlau, P.-J. (Physikalisch-Technische Werkstaetten, Freiburg i. B.). pp 539-46 of Radiation Protection Monitoring. Vienna, International Atomic Energy Agency, 1969.

From Regional Seminar for Asia and Far East on Radiation Protection Monitoring, Bombay, India. See STI/PUB-199; CONF-681203.

The necessity of primary or secondary standard laboratories is discussed. The calibration of a field instrument with the aid of primary and secondary standards is described together with the maximum accuracy obtainable. Finally, the complete set-up of a secondary standard laboratory is described. (auth)

47783 LARGE VOLUME Ge(Li)-DETECTORS FOR GAMMA-RAY SPECTROSCOPY. Ryndina, E. Z. At. Energ. (USSR), 27: 64-6(July 1969). (In Russian).

Construction and performance of a co-axial high-sensitivity large volume (30 cm^3) γ spectrometer are described. The detector was constructed using Hoboken Belgium materials with specific resistance of 18 to 26 ohm · cm, dislocation density 1100 to 2700 cm^{-2}, life-time of carrier 300 to 550 μsec with impurities of indium and gallium. The resolving power of the 30 cm^3 detector with the shift of 900 v without deduction of the device noises was 3.43 keV at 0.352 MeV energy, 3.95 keV at 1.333 MeV energy, and 7.05 keV at 6.621 MeV energy. The device noises were (2.0 ± 0.022 keV/pf) $C_{det.}$ where $C_{det.}$ = 50 pf. Tests were made of the detective efficiency using calibrated sources of ^{144}Ce, ^{203}Hg, ^{137}Cs, ^{65}Zn and ^{22}Na at 10 cm distance from the front window. (R.V.J.)

47784 MONITORING OF WASTE WATER ACTIVITY IN THE CENTRAL RESEARCH INSTITUTE FOR PHYSICS. Erdelyvari, Istran. KFKI (Kozp. Fiz. Kut. Intez.) Kozlem., 17: 223-34(1969). (In Hungarian).

The waste water discharged from the radioactive laboratories of the Central Research Institute for Physics and the Institute of Isotopes is checked twice before leaving the area of the Institutes. The activity is measured first in the collector shafts located near the exposed premises, then at the continuously operated measuring and sampling station installed near the boundary of the establishment. At this station the gamma activity of the waste water is measured and recorded currently day and night. 24 hour average sampling is routinely performed and the discharge rate/ m^3/min./ of the water is also currently measured and recorded. If the gamma activity level of the water increases above a given value, a device for instantaneous sampling is switched on automatically or manually. (tr-auth)

Nuclear Spectroscopic Instrumentation

Refer also to abstracts 49312, 49353, and 49393.

47785 (IA-1193) GLDT: AN IMPROVED FORTRAN IV COMPUTER PROGRAM FOR THE LEAST SQUARES ANALYSIS OF GAMMA-RAY SPECTRA. Gavron, A. (Israel Atomic Energy Commission, Tel Aviv). May 1969. 17p. Dep. CFSTI (U. S. Sales Only).

GLDT is a computer program which decomposes the gamma ray spectra of mixtures of radionuclides. Special attention was paid to the simplification of the input data, thus paving the way for complete automation of the data transfer from the multichannel analyzer to the computer. The computer automatically performs spectrum shifting, corrects the spectrum for detector or analyzer nonlinearity, compensates the number of counts in each channel for dead time losses, calculates the detection limit of each radionuclide component, and rejects superfluous radionuclide standards. (auth)

47786 SETUP OF A γ-γ COINCIDENCE SPECTROMETER AT THE THOR. Yang, Chio Ming (National Tsing Hua Univ., Hsinchu, Taiwan); Ma, David Ta-tao; Meng, Hsien Chun. Ho Tsu K'o Hsueh, 6: No. 3-4, 47-55(Apr. 1969).

A γ-γ coincidence spectrometer employing the double window technique for coincident background reduction has been set up at a horizontal beam port of the Tsing Hua Open-pool Reactor (THOR) in order to investigate nuclear level structures via the (n,γ) reaction. Its performance has been tested with a 10 μc ^{60}Co γ source. A simple example, illustrating the double window technique with the help of the spectra obtained, is given in explaining the working principle of the spectrometer. (auth)

47787 A NEW SINGLE-CHANNEL PULSE-HEIGHT ANALYSER. Bialkowski, Jacek (Inst. for Nuclear Research, Swierk, Poland). Nukleonika, 14: 549-54(1969).

A transistorized single-channel pulse-height analyser with the output pulse attached to the peak of the input pulse is described. This circuit operates from positive pulses 0.1–10 μs with rise and fall-times ranging from 0.1 to 1 μs. The range of discrimination for pulses formed by the time constant $\tau_{diff} = \tau_{int} = 0.5$ μs is 0.25–10 V for the lower level and 0.15–6 V for the channel width. Thermal stability of both discriminators is better than 1 mV/°C up to 45°C. The dead time is smaller than 1 μs for a pair of pulses. Time position instability of the output pulse is smaller than 0.4 μs for the input pulse obtained by differentiation and integration with 1 μs time constant of a rectangular pulse. (auth)

47788 SPECTROMETRY OF FAST NEUTRONS. Deconninck, G.; Meulders, J. P. (Univ., Louvain, Belgium). Rev. Phys. Appl., 4: 243-4(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

A data processing method is presented which allows the determination of the neutron component in time of flight spectra. Separation of neutrons as well as efficiency corrections are obtained by numerical methods. (auth)

47789 MULTIANGULAR DEVICE FOR MEASURING THE ASYMMETRY OF NEUTRONS. Sene, R.; Kahane, J.; Delpierre, P.; Heyman, M. Rev. Phys. Appl., 4: 245-6(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

The multiangular time-of-flight device described allows one to work with eight detection lines and a 400 channels pulse-height analyzer. The flight-time resolution throughout one month increases from 1.5 ns (instantaneous resolution) to 2.5 ns. (auth)

47790 SPECTROMETER FOR ENERGETIC PHOTONS OF WEAK INTENSITY. Degre, A.; Schaeffer, M.; Suffert, M. (CRN, Strasbourg). Rev. Phys. Appl., 4: 247-8(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

The description of a gamma-ray spectrometer for photons of about 25 MeV is given. The system includes antipile-up and good cosmic-ray shielding. (auth)

47791 CONFERENCE ON EXPERIMENTAL METHODS IN NUCLEAR PHYSICS AND IN PARTICLE PHYSICS, STRASBOURG, DECEMBER 4–6, 1968. Rev. Phys. Appl., 4: 99-340(June 1969). (In French and English). (CONF-681208-(Suppl.)).

Separate abstracts were prepared for 116 of 129 papers presented in the supplement. Nine abstracts were previously included in NSA. For abstract numbers of these papers see CONF-681208-(Suppl.) in the report number index. Four papers were in abstract form only and were not included. (B.G.D.)

For abstracts of individual papers see: 47750–47753, 47755–47766, 47788–47790, 47792–47811, 47816–47839, 47885–47906,

47914, 49081, 49259, 49261–49281, 49304, 49319, 49336, 49337, and 49452–49454.

47792 IDENTIFICATION AND ENERGY MEASUREMENT BY MAGNETIC SPECTROMETER. Jacmart, J. C.; Liu, M.; Mazloum, F.; Riou, M.; Roynette, J. C.; Stephan, C. (Institut de Physique Nucleaire, Orsay, France). Rev. Phys. Appl., 4: 99-101(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

The principle and characteristics of the identification technique by magnetic spectrometry and energy measurement is briefly given. Its use with three position solid-state detectors and IBM 360 computer is described. Its future application to the identification of super-heavy nuclei is presented. (auth)

47793 SIMULTANEOUS MEASUREMENTS OF THE d(p,2p)n CROSS SECTION IN 12 KINEMATICAL CONDITIONS. Moriet, M.; Frascaria, R.; Geoffrion, B.; Marty, N.; Tatischeff, B.; Willis, A. (Institut de Physique Nucleaire, Orsay, France). Rev. Phys. Appl., 4: 101-2(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

Three simple telescopes detecting the particles at 3 energies selected by a magnetic spectrometer associated with 4 range-telescopes permit with the help of a fast electronic, of a hodoscope, and of a multichannel analyzer the simultaneous measurement of true and random d(p,2p)n events in 12 kinematical conditions. (auth)

47794 MAGNETIC SELECTOR FOR REGISTERING ELECTRON SPECTRA WITH SILICON DETECTORS. Paris, P. (Centre de Spectrometrie Nucleaire et de Spectrometrie de Masse, Orsay, France); Treherne, J. Rev. Phys. Appl., 4: 291-2(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

For counting electrons by eliminating γ rays, x rays, α particles and positrons, silicon detectors were used in a uniform magnetic field. The energy range has upper and lower boundaries. (auth)

47795 PAIR AND ANTI-COMPTON SPECTROMETER. Girard, J.; Samama, R.; Carlos, P.; Maier, B. P.; Perrin, G. (CEN, Saclay, France). Rev. Phys. Appl., 4: 261-2(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

A gamma ray spectrometer working either in the anti-Compton or in the pair mode is described. It is composed by a 10 cm^3 Ge(Li) detector surrounded by a large NaI(Tl) annulus which is divided in 6 sectors. The pulses coming from these sectors are combined and used to condition the analysis of the pulses detected by the Ge(Li) detector. (auth)

47796 DEVELOPMENT AND ADJUSTMENT OF A Ge(Li) COMPTON SPECTROMETER. Oria, M.; Ripon, R.; Lepetit, J. (Institut National des Sciences et Techniques Nucleaires, Saclay, France). Rev. Phys. Appl., 4: 267-8(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

A single crystal Ge(Li) Compton spectrometer is described and has been tested. (auth)

47797 HIGH RESOLUTION MEASUREMENTS OF GAMMA RAYS FROM (n,γ) REACTIONS. Van Assche, P. H. M. (SCK-CEN, Mol, Belgium). Rev. Phys. Appl., 4: 269-70(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

A comparison has been made between a semiconductor detector and a diffraction spectrometer when used in the analysis of neutron capture gamma radiation. (auth)

47798 STUDY OF (n,n'γ) REACTIONS WITH Ge(Li) DETECTORS. Klotz, G.; Walter, G. (Centre de Recherches Nucleaires, Strasbourg). Rev. Phys. Appl., 4: 271-2(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

A high resolution γ-ray spectrometer using a Ge(Li) detector for (n,n'γ) measurements at 14.5 MeV bombarding energy, is described. Preliminary results for the $^{31}P(n,n'\gamma)^{31}P$ reaction are reported. (auth)

47799 GAMMA SPECTROMETRY WITH Ge(Li) DETECTORS BETWEEN 0 AND 14 MeV. Gonidec, J. P.; Walter, G. (Centre de Recherches Nucleaires, Strasbourg). Rev. Phys. Appl., 4: 273-4(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

A method is proposed for energy calibration of a Ge(Li) spectrometer between 0 and 14 MeV. The detection efficiency variation of this detector in the same range of photon energy was measured at the three resonances, E_p = 655, 992, and 2,489 keV, in the $^{27}Al(p,\gamma)^{28}Si$ reaction. (auth)

47800 Ge(Li) TOTAL ABSORPTION SPECTROMETERS. Henck, R.; Siffert, P.; Coche, A. (Centre de Recherches Nucleaires, Strasbourg). Rev. Phys. Appl., 4: 277-8(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

Several two crystal Ge(Li) detector systems have been developed for use as total absorption spectrometers, as well as a 52 cm^3 well-type detector. (auth)

47801 USE OF A HYBRID PHOTOMULTIPLIER IN A NUCLEAR SPECTROMETER. Chevalier, P. (Laboratoire d'Electronique et de Physique Appliquee, Limeil, France). Rev. Phys. Appl., 4: 229(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

The principle of the hybrid photomultiplier which we are studying at LEP was presented at the Colloque International sur l'Electronique Nucléaire at Versailles in September 1968. The results obtained by using this new photomultiplier in nuclear scintillation spectrometry are presented. (auth)

47802 PULSED VAN DE GRAAFF FOR TIME-OF-FLIGHT NEUTRON SPECTROMETRY. Hebert, D.; Leroy, J. L.; Arnaud, A. (CEN, Cadarache, France). Rev. Phys. Appl., 4: 163-4(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

Fast neutron time-of-flight work is in progress at Cadarache using a pulsed 5 MV Van de Graaff. The features of the pulsed radiofrequency ion source and of the bunching magnet are described. Proton or deuteron bursts of less than 2 ns are obtained at the target, with an average current of 4 μA. (auth)

47803 APPLICATION OF THE METHOD OF SATURATED TRANSFORMERS TO THE MEASUREMENT AND REGULATION OF THE MAGNETIC FIELD OF A DOUBLE-FOCUSING $\pi\sqrt{2}$ β SPECTROMETER WITH AN IRON CORE. Dionisio, J. S.; Guterman, C. Rev. Phys. Appl., 4: 195-7(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

A new device, derived from the flux gate method, is described. This instrument can be applied to the measurement of constant or slowly varying magnetic fields in the range between 10^{-4} and 3×10^2 Oe. Its accuracy is, at least, 2.5×10^{-5} between 7 and 300 Oe. The magnetic field of a double focusing $\pi\sqrt{2}$ magnetic β spectrometer of the Siegbahn-Svartholm type is stabilized with an accuracy of the same order of magnitude using the error signal between the voltage proportional to the magnetic field induction and the reference voltage. (auth)

47804 AN IRON-FREE $\pi\sqrt{2}$ β SPECTROMETER OF 50 cm. Baudry, A.; Gizon, J.; Moussa, A. (CEN, Grenoble, France). Rev. Phys. Appl., 4: 199-200(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

A fifty centimeter radius iron-free double-focusing $\pi\sqrt{2}$ Chalk-River type β spectrometer is very briefly described. The energy range is 3 keV-3.6 MeV. The highest resolution achieved is 1.4×10^{-4}. (auth)

47805 SPECTROMETER WITH ADJUSTABLE OPTICAL PARAMETERS. Bazin, C.; Dupin, J. (Laboratoire de l'Accelerateur Lineaire, Orsay, France). Rev. Phys. Appl., 4: 201-2(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

A system of pole-face windings provides this spectrometer with magnetic characteristics independent of the induction. These characteristics concern the first and second order coefficients, the focal plane angle and the dispersion. It was demonstrated that the range over which the optical characteristics are constant have, by this method, been extended from 0.8 to 1.27 GeV/c. (auth)

47806 INCREASE OF THE LUMINOSITY OF A β SPECTROMETER. Boving, R.; Piron, J.; Jones, A. (Univ. Catholique de

Louvain, Heverle, Belgium). Rev. Phys. Appl., 4: 203-4(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

This spectrometer, with iron, is made of two sectors and a Glaser's lens. In order to increase the luminosity of the apparatus some arrangement for electrostatic compensation at the source has been studied. (auth)

47807 A SPHERICAL ELECTROSTATIC β SPECTROMETER. Barat, J. L.; Boyer, P.; Guisset, M. (CEN, Grenoble, France). Rev. Phys. Appl., 4: 205-6(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

The performance of an electrostatic β spectrometer with spherical electrodes has been determined. Results show the value of this type of analyzer for low energy coincidence spectrometry studies. (auth)

47808 SPECTROMETER WITH HIGH RESOLUTION FOR ELECTRON SCATTERING. Bellicard, J. B.; Leconte, Ph. (CEN, Saclay, France). Rev. Phys. Appl., 4: 207-8(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

The study which has enabled us to choose the characteristics of a high resolution, good solid angle spectrometer and fairly large energy acceptance is outlined. (auth)

47809 DOUBLE-FOCUSING SPECTROMETER WITH LARGE ENERGY ACCEPTANCE. Bounin, P.; Mougey, J. (CEN, Saclay, France). Rev. Phys. Appl., 4: 209-10(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

It is shown how the authors were led to build a double-focussing magnetic spectrometer, of great energy acceptance (from -30% to +10% of the mean momentum). The required features in resolution, dispersion, over all dimension, etc., are presented. (auth)

47810 CALIBRATION OF A MAGNETIC SPECTROMETER OF THE BUECHNER TYPE AND REPRODUCIBILITY OF MEASUREMENTS. Bianchi, L. (CEN, Saclay, France). Rev. Phys. Appl., 4: 211-12(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

The reproducibility and calibration were performed using $^{4}He^{++}$ and $^{4}He^{+}$ from ^{212}Po, ^{212}Bi. The precision obtained for the energy is: $\Delta E/E \leq 2 \times 10^{-4}$, for the following magnetic rigidity range $350 < (B\rho) < 850$ kG/cm. (auth)

47811 PROGRAM ORBITE: PARTICLE TRAJECTORIES IN A MAGNETIC FIELD. Leconte, Ph.; Mougey, J. (CEN, Saclay, France). Rev. Phys. Appl., 4: 213(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

The Orbite code for calculating trajectories of charged particles in a magnetic field is described. (auth)

47812 BETA-RAY SPECTROSCOPY USING A HOLLOW PLASTIC SCINTILLATOR. Szepke Ryszard (Inst. of Nuclear Research, Warsaw). Nukleonika, 14: 407-13(1969).

Direct and scattered beta-ray spectra of such radionuclides as ^{147}Pm, ^{204}Tl and $^{90}Sr + ^{90}Y$ were investigated. Significant variations were observed particularly of the shape of spectra with the spectrometer, scattering material and geometry used. The results obtained are plotted in the Figures. (auth)

47813 APPLICATION OF SEMICONDUCTOR GAMMA-SPECTROMETER FOR STUDYING SOME CHARACTERISTICS OF CERAMIC FUEL ELEMENTS. Davydov, E. F.; Sukhikh, A. V.; Syuzev, V. N.; Ivanov, V. I. At. Energ. (USSR), 27: 224-5(Sept. 1969). (In Russian).

Descriptions are given of a design and performance of a Ge(Li)-semiconductor γ-spectrometer with a sensitivity thickness of 8 mm and resolving power along the ^{137}Cs line of 6 keV. A collimating device is capable of varying the γ-quantum flux from irradiated fuel elements where the geometric dimensions of the collimating opening varied from $5 < \phi < 20$ mm and the length of collimator was 1500 mm. Physical characteristics of uranium dioxide in a stainless steel cladding were studied at 500 to 600°C. The distribution of the fuel along the ampule and migration of fission elements were studied after irradiation. Data obtained on the distribution of fuel density and fission fragments of ^{137}Cs and $^{95}Zr + ^{95}Nb$ were used for determining the behavior of the fuel. (R.V.J.)

47814 MEASUREMENT OF THE INTENSITIES OF GAMMA TRANSITIONS USING A TOROIDAL BETA SPECTROMETER. Gasior, Marian; Niewodniczanski, Henryk; Sieniawski, Jerzy (Inst. of Physics, Kharkov). Nukleonika, 14: 235-45(1969). (In Polish).

A method of measuring the intensities of gamma transitions using a toroidal iron free beta-ray spectrometer was developed and a suitable set of converters prepared. The optimum geometry of the converters was found experimentally for the gamma-ray energy range 0.2 to 1.3 MeV, the resolution being of the order of 0.5%. (auth)

High Energy Physics Instrumentation

Refer also to abstract 49028.

47815 (NP-17994) ANNUAL REPORT, 1968. (Commissariat a l'Energie Atomique, Paris (France)). 158p. (In French). Dep. CFSTI (U. S. Sales Only).

Fundamental research in theoretical physics, accelerators and instrumentation for high energy and nuclear physics, elementary particle, nuclear, atomic, and solid state physics, controlled nuclear fusion, chemistry, biology, production of energy, military applications, production of the base materials for nuclear energy, production and application of radioisotopes, radiation protection and safety, reactor development, and international public relations in 1968 are summarized. (W.H.K.)

47816 FAST LOGIC FOR PROCESSING OF HIGH-ENERGY PHYSICS INFORMATION. Brehin, S.; Brisson, J. C.; Lemoine, M.; Raoul, J. C. (CEN, Saclay, France). Rev. Phys. Appl., 4: 157-8(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

The use of fast integrated circuits to build spark chamber triggering logics allows one to obtain a data processing time less than 100 ns with an input resolving time of 6 ns. The logical principle is detailed and two examples are given. (auth)

47817 USE OF A COMPUTER WITH A SPARK CHAMBER. Katz, A.; Segalas, R. (CEN, Saclay, France). Rev. Phys. Appl., 4: 113-14(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

First, experimental equipment is described and the computer which is the heart of the on-line system is examined. The second part includes the methods used for the electronics as well as for programming the experiment. (auth)

47818 GAMMA SPECTROMETRY FOR STUDYING THE REACTION $\pi^{-}p \rightarrow \pi^{0}\pi^{0}n$ AT 2 GeV/c. Ernwein, J. (CEN, Saclay, France). Rev. Phys. Appl., 4: 295-6(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

In order to study $\pi^{-}p \rightarrow$ neutrals at 2 GeV/c a large gap cylindrical spark chamber in a 19 kg magnetic field was used as a spectrometer for γ-rays. The triggering mode and the optical set-up are described as well as the physical properties of the experimental layout. (auth)

47819 CHERENKOV COUNTER WITH FLUORESCENT MATERIALS. Cosme, G.; Jullian, S.; Lefrancois, J. (Laboratoire de l'Accelerateur Lineaire, Orsay, France). Rev. Phys. Appl., 4: 297-8(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

The use has been studied of light shifting substances dissolved in a liquid Cherenkov counter. It was found that POPOP was the most suitable shifter studied. Ethylene glycol and bromobenzene were found to be good solvents. The light gain when using a shifter was approximately 2.5. A counter based on these properties was used to detect disintegration products of K^{+} mesons. (auth)

47820 REDUCTION OF TRANSIT TIME IN A PHOTOMULTIPLIER. Berst, J. D.; Chatelus, Y.; Erickson, E. (Institut de Recherches Nucleaires, Strasbourg). Rev. Phys. Appl., 4: 299-300(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

In order to reduce the delay to trigger a spark chamber, a special distribution of the voltages in a phototube has been studied; the transit time has been reduced to 20 ns without any loss of stability or reliability. (auth)

47821 A NEUTRON DETECTOR FOR MISSING-MASS SPECTROMETRY. Bollini, D.; Buhler-Broglin, A.; Dalpiaz, P.; Massam, T.; Navach, F.; Navarria, F. L.; Schneegans, M. A.; Zichichi, A. (CERN, Geneva. Univ., Bologna. Istituto Nazionale di Fisica Nucleare, Bologna. Centre de Recherches Nucleaires, Strasbourg). Rev. Phys. Appl., 4: 301-2(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

A large (2×0.39 m^3 plastic scintillator) neutron detector capable of measuring with high accuracy the coordinates of the neutron interaction point as well as its time-of-flight is described. As a missing mass spectrometer, it allows observation of, for example, the η meson with a mass resolution of ± 4.2 MeV. (auth)

47822 MEASUREMENT OF ELECTRON ENERGY IN A BUBBLE CHAMBER. Bugadov, Y. (CERN, Geneva); Venus, W.; Arnold, R. Rev. Phys. Appl., 4: 302-3(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

By using the photons resulting from the decay of neutral pions in a limited volume of freon, a calibration has permitted a relation to be obtained between the energy of an electron and the total length of the tracks of the shower initiated by this electron. (auth)

47823 CYLINDRICAL WIRE SPARK CHAMBER WITH REGISTRATION BY FERRITES. Taylor, A. E. (Atomic Energy Research Establishment, Harwell, Eng.); Blair, I.; Astbury, A.; Axen, D.; Kalmus, P.; Gouanere, M. Rev. Phys. Appl., 4: 304-5(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

Cylindrical wire spark chambers were used with a core reading system in a low counting experiment. These chambers leave a small amount of material in the beam, to reduce the background due to other reactions. (auth)

47824 LOCALIZATION OF PARTICLES BY A SPARK CHAMBER. Beer, O.; Laspalles, C.; Terrien, Y.; Vallois, G. (CEN, Saclay, France). Rev. Phys. Appl., 4: 305-6(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

The spark-chamber particle detection system used at the Saclay cyclotron is described. The high voltage is applied only for the type of particle desired. Any triggering is automatically forbidden during the dead time of the chamber. The localization by current division is improved by the normalization of the localization signal by the total charge which flows across the chamber. (auth)

47825 ACOUSTIC SPARK CHAMBER FOR LOW-ENERGY ELECTRONS. Metzger, G.; Riedinger, M.; Schmitt, F.; Gresser, J.; Sutter, G. (Institut de Recherches Nucleaires, Strasbourg). Rev. Phys. Appl., 4: 307-9(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

In order to measure conversion electron pairs a magnetic spectrometer has been constructed, using sonic spark chambers. The sonic circuit and its performance (spark located at ± 0.06 mm in a 75 cm^2 area) are described. (auth)

47826 SPECTROMETER USING MAGNETOSTRICTIVE CHAMBERS. Abillon, J. M.; Borg, A.; Bruere-Dawson, R.; Crozon, M.; Mendiburu, J. P.; Poutot, D.; Patiou, A.; Leray, T.; Tocqueville, J. Rev. Phys. Appl., 4: 313-14(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

The design and performance characteristics of a set of eight magnetostrictive spark chambers used in a $\pi^- - p$ backward scattering experiment are described. Construction details and the main performance characteristics (track localization, repetition rate) are emphasized. (auth)

47827 FILM ADVANCE SYSTEM OF A SPIRAL READER. Guignard, C.; Marchand, D.; Moynot, M. Rev. Phys. Appl., 4: 315-17(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

The spiral reader is equipped with a simultaneous film advance system for the three stereoscopic views and with two formats for the 0.80 and 2 m chambers. The three films can be advanced independently under the control of a computer. (auth)

47828 SIMPLIFICATION OF PREMEASUREMENTS ON BUBBLE CHAMBER FILM FOR ANALYSIS ON THE HPD. Pichon, G.; de La Vaissiere, C.; Yiou, T. P. (Institut de Physique Nucleaire, Paris). Rev. Phys. Appl., 4: 317-18(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

A method to simplify the premeasurements necessary for treatment of bubble chamber pictures by the HPD consists in premeasuring only on two stereoscopic views and in determining the third one by a geometrical calculation. The principle consists in using the geometrical configuration of the cameras of the bubble chamber. The results obtained for the CERN 2m H.B.C. as well as the validity of the proposed method are discussed. (auth)

47829 NORMALIZATION OF THE PHOTOMULTIPLIER SIGNAL IN FILM ANALYSIS. Fontaine, G.; Guignard, C. (College de France, Paris). Rev. Phys. Appl., 4: 319-20(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

The signal from an element of analysis is kept automatically constant in the absence of any track, thus enabling the occulted area of this element to be measured. A variable gain amplifier is used in a feedback loop. When a tract is detected, this loop is opened by a field effect transistor commutation. (auth)

47830 NEW TECHNIQUES IN THE FILTERING OF HPD DATA. de La Vaissiere, Ch. (Institut de Physique Nucleaire, Paris). Rev. Phys. Appl., 4: 321-2(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

Some techniques using the geometrical correlations in the same frame are proposed for the off-line filtering of HPD data. The filtering is made less dependent on the premeasurements. The computer-time or the premeasurements can be reduced. (auth)

47831 ARIANE: DEVICE FOR AUTOMATIC FILM ANALYSIS. Dillet, A.; Goldwasser, M.; Michau, J. C.; Mullie, J.; Pichard, B.; Riols, G. (CEN, Saclay, France). Rev. Phys. Appl., 4: 323-4(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

Ariane is an automatic device for the analysis of spark chamber pictures. It is essentially a flying-spot on line with a small computer. Four experiments (more than one million pictures) have now been successfully processed. A new apparatus, greatly improved, is just beginning to operate. (auth)

47832 USE OF THE HPD APPARATUS AT THE COLLEGE DE FRANCE. Reboul, G. Rev. Phys. Appl., 4: 325(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

The HPD is controlled by a small computer. Few tests are on-line, and the operator must participate actively in the measurement process. A display scope and a typewriter connected to the computer establish a man-machine dialogue. Production results from Oct. 1967 to Nov. 1968 are presented. (auth)

47833 CONNECTION OF MEASURING APPARATUS TO A COMPUTER. Barrelet, E.; Bizeau, C.; Davidian, M. Rev. Phys. Appl., 4: 326(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

A set of 17 bubble chamber picture devices are connected to a Univac 418 computer, verifying, with a real time FORTRAN program, the validity of the measurements and ensuring, in time-sharing, the management of scanning and measurement. (auth)

47834 ON-LINE OPERATION OF THE MEASUREMENT DEVICES OF THE BUBBLE CHAMBER GROUP (HYDROGEN). Gay, J. F.; Jegham, E.; Michalon, A. (CRN, Strasbourg). Rev. Phys. Appl., 4: 327(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

In order to improve the quality of measurements and to increase efficiency, the Bubble Chamber Group (hydrogen) has worked out the on-line operation of its measurement devices with an IBM 1800 computer working in real time. A sophisticated dialogue has been established between the computer and the operator with a precise guide of measurement which avoids the errors of handling. (auth)

47835 DIGITIZED SPIRAL READER. Rossa, E. Rev. Phys. Appl., 4: 329-30(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

A description is given of a semi-automatic measuring machine for bubble chamber photographs developed as a CERN-Collège de France collaboration from Berkeley's spiral reader. The essential optical and mechanical parameters and the first results are given for the CERN device. (auth)

47836 COCCINELLE: AN AUTOMATIC ANALYSIS DEVICE. Equer, B.; Guignard, C.; Reboul, G.; Volte, A.; Fontaine, G. (College de France, Paris). Rev. Phys. Appl., 4: 333-4(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

A pattern recognition and measurement machine is described. Two essential features are a pulse correlation circuit which detects all linear elements, and the machine works with increasing accuracy as the gathered information increases. (auth)

47837 VIDEO SIGNAL PROCESSING OF A SPIRAL READER. Boget, D.; Moynot, M.; Reboul, G. Rev. Phys. Appl., 4: 331-2 (June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

The video signal processing includes pulse discrimination and pulse normalization in order to obtain a relative measure of track reflectance and determination of pulse center and pulse height. This last process is made by continuous analog to digital conversion of the pulse. (auth)

47838 DESIGN OF A HYDRAULIC EXPANSION SYSTEM FOR A HEAVY LIQUID BUBBLE CHAMBER. Lefrancois, A. (CERN, Geneva). Rev. Phys. Appl., 4: 239-40(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

The expansion is caused by the movement of a piston acting on the liquid of the chamber through an oil cushion and a membrane. The piston is operated during the expansion by means of two independent valves; it is then maintained in position of compression by means of a positioning servomechanism. (auth)

47839 PROCESSING OF INFORMATION FROM A MAGNETOSTRICTIVE SPARK CHAMBER. Bruere-Dawson, R.; Dumont, J. C.; Marqueste, Ph.; Rabany, M.; Turlot, J. P. Rev. Phys. Appl., 4: 155-6(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

Comprehensive view and description of an electronic device used for handling the information from magnetostrictive spark chambers are given. Then follows the general disposition, the results obtained and future developments. (auth)

47840 A DETERMINATION OF THE REFRACTIVE INDEX OF LIQUID DEUTERIUM USING THE CHERENKOV EFFECT. Ayres, D. S. (Univ. of California, Berkeley); Cormack, A. M.; Greenberg, A. J.; Kenney, R. W.; Caldwell, D. O.; Elings, V. B.; Hesse, W. P.; Morrison, R. J. Physica, 43: 105-8(July 1, 1969).

We have found the refractive index of liquid orthodeuterium at 24.2 K and 3200 Å to be 1.1321 ± 0.0025. This is in agreement with the value calculated from the Lorentz-Lorenz relation, the Lorentz theory of the dielectric constant, and the measured dispersion of deuterium gas. Our measurements also yield a rough value for the difference in molecular polarizabilities of deuterium and hydrogen, $\Delta\alpha/\alpha = (2.3 \pm 1.9)\%$. The measurement was a coincidental result of a particle-physics experiment in which Cherenkov counters were used with either liquid hydrogen or liquid deuterium as a radiating medium. The ratio of the refractive indices of the two substances was determined from the change in response of the counters when the radiating medium was changed. (auth)

47841 ON THE NON-UNIQUENESS OF THE DETERMINATION OF THE PARTICLE DENSITY IN A SHOWER BY A LOGARITHMIC FORMULA. Jatczak, Jerzy (Univ. of Lodz, Poland). Nukleonika, 14: 447-59(1969).

The problem of determining the particle flux density in an extensive air shower of cosmic radiation by means of the formula $\rho = [(1/s) \ln (K/K - k)]$ is discussed. The weighed mean particle density calculated from experimental data is found to depend on the division of the total number of GM-counters in the shower-recording system into subsystems for establishing the local density of the particles. This effect is subjected to a statistical and analytical analysis. This non-uniqueness in the determination of the particle flux density in a shower is shown to be associated with the logarithmic formula itself. (auth)

47842 SOME NEW DETECTOR SYSTEMS. Lindenbaum, S. J. (Brookhaven National Lab., Upton, N. Y.). pp 419-41 of Meson Spectroscopy. Baltay, Charles (ed.). New York, W. A. Benjamin, Inc., 1968.

A single-arm counter-hodoscope magnetic spectrometer system used on-line at BNL AGS for single-particle detection and momentum measurement is described. A brief description is also given of a single-arm spark-chamber (wire) hodoscope magnetic spectrometer system. A new double vertex magnetic spectrometer detector under development at BNL is discussed. (L.B.S.)

47843 TOTAL ABSORPTION DETECTORS FOR HIGH ENERGY PHYSICS. Hofstadter, Robert (Stanford Univ., Calif.). pp 443-54 of Meson Spectroscopy. Baltay, Charles (ed.). New York, W. A. Benjamin, Inc., 1968.

Three principle developments for detectors with the desirable features for spectroscopy studies in elementary particle physics are discussed: Cherenkov counter development; improved energy resolution of NaI(Tl) crystal spectrometers; and the development of total absorption nuclear cascade (tanc) detectors. (L.B.S.)

Radiation Dosimeters

Refer also to abstracts 47475, 47560, 47748, 47875, 48045, 48051, and 48058.

47844 (K-1763) NEW NEUTRON DOSIMETER AND NEUTRON-SPECTRUM MODEL FOR NUCLEAR ACCIDENT DOSIMETRY. Bailey, J. C. (Oak Ridge Gaseous Diffusion Plant, Tenn.). Oct. 2, 1969. Contract W-7405-eng-26. 67p. Dep. CFSTI.

The ORGDP nuclear accident dosimeter utilizes bare and cadmium-covered gold for the measurement of thermal neutrons, cadmium-covered gold and boron-shielded copper for the measurement of resonance neutrons, and sulfur and boron-shielded indium for the measurement of fast neutrons. To avoid orientation effects resulting from self-shielding, the gold and copper are in the form of spherical shells. Interpretation of the measurements is based upon a spectral model comprising a thermal region from 0 to 0.5 eV; a slowing-down region from 0.5 eV upward, in which the fluence per unit logarithm of energy is a linear function of log E, but weighted by the fraction of neutrons originating in the fission spectrum at energies higher than E; and a fast region having the shape of a fission spectrum but with energies which may be shifted from those of the fission spectrum by a constant factor. The copper and gold measurements are considered to define the entire slowing-down spectrum, and the shift of the fast portion of the spectrum is determined from the indium-to-sulfur response ratio after these respective values have been corrected for the contribution of the slowing-down spectrum. This dosimetry scheme was tested experimentally with 4 different neutron spectra. The dosimeter yielded first-collision tissue doses in air which agreed with absolute proportional counter determinations to ±10%. Doses to phantoms determined from the spectral data of the dosimeter and the activation of saline solution in the phantoms agreed with proportional counter values to within ±13%. Comparisons of experimental responses of plutonium, neptunium, and uranium fission foils of the Hurst threshold detector unit with responses which would be expected on the basis of the spectral interpretation described above showed a bias of 15% between the two methods. With correction for this bias, the comparisons were within 15% in all cases. To permit these comparisons, a 100-group neutron transport code for the IBM-7090 computer was used to calculate effective cross sections for the fission foils when they are shielded by 1.65 grams of ^{10}B per square centimeter, as in the Hurst unit. The results of these calculations are given. (auth)

47845 (KFK-845, pp 2,1-4) APPLICATION OF THE QUANTIMET TO THE AUTOMATIC EVALUATION OF THE NEUTRON TRACKS IN PHOTOPLATES. Durcansky, G.; Schmatz, W. (Kernforschungsanlage, Juelich (West Germany. Institut fuer Festkoerper- und Neutronenphysik). (In German).

Darkening effects on photoplates were produced by neutron-induced light flashes. These plates can be evaluated in the quantimet. (The quantimet is a device with which desired characteristics in photographs can be quantitatively detected according to surface, size, or number.) Neutron tracks were quantitatively and completely automatically detected from the anisotropic small angle scattering figures of slow neutrons on photoplates. (tr-auth)

47846 (NYO-2740-6, pp 145-65) ESTIMATION OF DOSE EQUIVALENT FROM PROPORTIONAL CHAMBER CURRENT VARIATION. Bengtsson, L. G. (Columbia Univ., New York. Radiological Research Lab.).

An approximate method is described for simple measurement of dose equivalent from proportional current variation, which can be applicable over a wide spectrum of radiations. (B.G.D.)

47847 (NYO-2740-6, pp 167-98) LOW VOLTAGE X-RAY GENERATOR DOSIMETRY. Clark, B. C.; Gross, W. (Columbia Univ., New York. Radiological Research Lab.).

The determination of the dose received by a biological specimen exposed to the x-ray beam from an x-ray generator requires a system for monitoring specimen irradiation and a method of con-

verting the reading of the monitor system into an absorbed dose in the sensitive region of the spore. The first requirement has been met with a monitor ionization chamber. To meet the second requirement, measurements with an extrapolation-type ionization chamber have been combined with theoretical calculations to evaluate the conversion factors. (auth)

47848 (NYO-2740-6, pp 207-8) MODIFIED TISSUE EQUIVALENT LIQUID. Goodman, L. J. (Columbia Univ., New York. Radiological Research Lab.).

A modified tissue-equivalent liquid containing water (65.6%), glycerol (26.8%) and urea (7.6%) is described. (B.G.D.)

47849 THE DOSIMETRY OF VERY HIGH INTENSITY PULSED ELECTRON SOURCES USED FOR RADIATION CHEMISTRY. II. DOSIMETRY FOR GASEOUS SAMPLES. Willis, C.; Miller, O. A.; Rothwell, A. E.; Boyd, A. W. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Advan. Chem. Ser., No. 81, 539-49(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.1).

Adiabatic calorimetry was used to measure the mean dose in a cell used for the irradiation of gaseous samples with very high intensity electron pulses at a dose rate of about 10^{27} eV/gram sec. The calorimeter was a thin aluminum disc, and the temperature rise caused by the pulse was measured by an attached thermocouple. By using discs of different thicknesses and extrapolating to zero thickness, the dose in an infinitely thin absorber was obtained. This was corrected for the difference in electron stopping power between aluminum and the gases. Using this dose, the nitrogen yield from nitrous oxide was found to be $G(N_2) = 12.4 \pm 0.2$. The temperature of the nitrous oxide was initially 25°C but increased to ~50°C on irradiation. The hydrogen yield from ethylene was found to be pressure dependent. At one atm., $G(H_2) = 1.9$ and decreases to 1.0 at 10 atm. (auth)

47850 A SIGNIFICANT CORRECTION FACTOR IN GAMMA RAY DOSIMETRY. Brnjolfsson, Ari (Army Natick Labs., Mass.). Advan. Chem. Ser., No. 81, 550-67(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.1).

Softening of the gamma rays as they penetrate light materials may cause very large differences in the radiation doses absorbed in the samples and in the dosimeters. This is illustrated by calculating the dose in 14 dosimeters and several other materials placed at distances of 0, 1, 2, and 4 relaxation lengths from a point isotropic ^{60}Co source embedded in a large water container. These calculations show for instance, that the doses in water, Lucite, Fricke dosimeter, lithium fluoride, poly(vinyl chloride) and 0.4 M ceric sulfate solution at zero distance from the source are in the ratios: 100:96:100:83:92:99; at a distance corresponding to $\mu_t \cdot r = 1$ the dose ratios are 100:95:100:85:124:169; and at a distance corresponding to $\mu_t \cdot r = 4$ the similar ratios are: 100:93:101:87:162:251. (auth)

47851 OXALIC ACID DOSIMETER PROCEDURE. Holm, Niels W.; Sehested, K. (Danish Atomic Energy Commission, Roskilde, Denmark). Advan. Chem. Ser., No. 81, 568-78(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.1).

A review is given on the experiences with the oxalic acid dosimeter. The system was first suggested by Draganic, who has carried out extensive investigations on the dosimetric properties. Further experiments have been carried out at various laboratories—e.g., in the United States, Japan, and Denmark. Although the system suffers from some systematic weaknesses, it can be applied successfully, when properly calibrated under the conditions where it is to be used. Its application for ^{60}Co gamma and high dose-rate electron dosimetery is reported. (auth)

47852 FERROUS-CUPRIC DOSIMETER. Bjergbakke, E.; Sehested, K. (Danish Atomic Energy Commission, Roskilde, Denmark). Advan. Chem. Ser., No. 81, 579-84(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.1).

Air-free, air-saturated, and oxygenated solutions of the $Fe^{2+}-Cu^{2+}$ dosimeter have been investigated for ^{60}Co gamma and high dose-rate electron dosimetry. It has been shown that the dosage curves are not completely linear, but that an oxygenated or deaerated system may be used in the range 50 to 800 krad with an accuracy of 1%. The oxygenated system is for a 1.1 μsec pulse independent of dose-rate up to 100 rads/pulse, and the deaerated solution up to 500 rads/pulse. (auth)

47853 HYDRATED ELECTRON AND THERMOLUMINESCENT DOSIMETRY OF PULSED X-RAY BEAMS. Fielden, E. M.; Hart, Edwin J. (Argonne National Lab., Ill.). Advan. Chem. Ser., No. 81, 585-94(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.1).

Two dosimeters suitable for monitoring single pulses of x rays with doses in the range 1 to 100 rads at dose rates greater than 10^3 rads/sec are described. Both systems were independently referred to Fricke dosimetry as the absolute standard and cross checked under pulse conditions. In one system the transient hydrated electron absorption produced by the pulse is measured by kinetic spectrophotometry as an indication of the dose. In the other, doped LiF crystals of about 50 mg are irradiated in sealed polyethylene bags under conditions of electronic equilibrium. Readout of the irradiated crystals was done on a standard commercial machine. Both methods were readily capable of 5% precision and with a little care better than 3% is obtainable. (auth)

47854 PHOSPHOR-POLYTETRAFLUOROETHYLENE THERMOLUMINESCENT DOSIMETER. McCall, Richard C. (to Isotopes, Inc.). U. S. Patent 3,471,699. Filed Jan. 13, 1966.

A radiation dosimeter is described which consists of lithium fluoride phosphor particles embedded substantially uniformly throughout a polytetrafluoroethylene matrix, Also, a method is described for making the dosimeter which consists of thoroughly mixing the lithium fluoride particles with polytetrafluoroethylene particles, compressing the mixture by a factor from 5:1 to 8:1, heating the mixture to a gelling temperature of 350°C at a rate of 50°C per hour per half inch of mixture thickness and maintaining the terminal temperature for one hour per half inch of mixture thickness, and cooling the gelled mass at a rate substantially the opposite of the heating rate. (Offic. Pat. Gaz.)

47855 NEUTRON DOSIMETRY: METHODS OF MANAGEMENT. Nachtigall, D. (EURATOM, Geel, Belg.). pp 79-101 of Radiation Protection Monitoring. Vienna, International Atomic Energy Agency, 1969.

From Regional Seminar for Asia and Far East on Radiation Protection Monitoring, Bombay, India. See STI/PUB-199; CONF-681203.

The purpose of a dosimeter is defined and the requirements that it must fulfil are enumerated. A classification of dosimeters is then derived on the basis of the relationship between the amount of energy imparted to matter with which the radiation interacts and the quantity indicated by the measuring technique. On this basis the devices are classified as universal dosimeters, standard dosimeters and selective dosimeters, and examples are given of various types of neutron dosimeters under this classification. Methods for determining dose-equivalents are classified as conversion procedures, selective procedures and separate procedures, and examples are given of the use of these procedures. (65 references) (auth)

47856 NEUTRON PERSONNEL MONITORS CURRENTLY IN USE. Nagarajan, P. S. (Bhabha Atomic Research Centre, Trombay, India). pp 103-13 of Radiation Protection Monitoring. Vienna, International Atomic Energy Agency, 1969.

From Regional Seminar for Asia and Far East on Radiation Protection Monitoring, Bombay, India. See STI/PUB-199; CONF-681203.

Commonly used neutron personnel monitors are (1) a cadmium filter-film combination for thermal neutrons and (2) a nuclear emulsion pack for recording recoil proton tracks arising from exposure to fast neutrons. The various factors influencing the accuracy of these personnel monitors were investigated. It was found that angular dependence could lead to errors as high as 50% in the dose estimates. Further, a correction factor arising from neutron backscatter from the body has been recommended for the conventional thermal-neutron personnel monitor. This correction amounts to as much as 60-70% of the dose. The effect of backscatter in the case of fast-neutron personnel monitors is also discussed. The computed enhancement of observed track density due to backscatter compares well with the reported experimental value of about 30%. The secondary gamma dose-equivalent arising from neutron capture in the body has been estimated and the resulting correction to the total dose-equivalent is suggested. This correction compensates for the superfluous gamma dose-equivalent that is normally included in dose records. While it is negligible for fast neutrons, the correction amounts to about 13% of the neutron dose for isotropic incidence of thermal neutrons and to about 35% of the neutron dose for normal incidence of thermal neutrons. (auth)

47857 GENERAL VIEW OF THE DIFFERENT METHODS OF MEASUREMENT AND INTERPRETATION OF RESULTS IN MONITORING DOSIMETRY. Pychlau, P.-J. (Physikalisch-Technische Werkstaetten, Freiburg i. B.). pp 217-26 of Radiation Protection Monitoring. Vienna, International Atomic Energy Agency, 1969.

From Regional Seminar for Asia and Far East on Radiation Protection Monitoring, Bombay, India. See STI/PUB-199; CONF-681203.

A survey is given of the different types of instruments and the different fields of application in which these instruments can be used. Furthermore, the advantages and disadvantages of the different types of detector and instrument circuits are compared. Finally, the method of calibration is discussed. (auth)

47858 IMPROVED RADIOPHOTOLUMINESCENT DOSIMETER AND NEW NUCLEAR TRACK DETECTOR. Yokota, R. (Tokyo Shibaura Electric Co., Ltd., Kawasaki, Japan); Kinoshita, M.; Maruyama, M.; Nishiwaki, Y. pp 287-98 of Radiation Protection Monitoring. Vienna, International Atomic Energy Agency, 1969.

From Regional Seminar for Asia and Far East on Radiation Protection Monitoring, Bombay, India. See STI/PUB-199; CONF-681203.

A new dosimeter glass has been developed with a sensitivity 1.45 times greater than that of currently used glass, a 70% predose as compared with the present low predose, and a low atomic number. A new spherical badge case makes this new glass energy independent to 30 keV and good directional independence is achieved. A convenient apparatus for washing the dosimeter glass has also been developed, which enables reproducible readings to to be obtained to within ±2 mR. A device to project an enlarged image of the identification number written with a diamond pen on the glass within the cell is available and can be attached to the fluorimeter. As a result of the trapezoidal shape of the dosimeter glass and the cell, β-rays from 0.03 to 1 MeV (average energy) can be measured with high sensitivity. The badge case together with the glass is so small that it can be attached to the inner side of the forefinger. A nuclear track detector employing the etch-pit method and incorporating Toshiba phosphate glass and a thin film of fissionable material deposited on a gold foil is also described. The phosphate glass used in this detector is doped with Th and/or U, and the instrument thus has higher sensitivity and assures better protection for the exposure and better contamination of the fissile material than the usual fissile foil and insulator system. (auth)

47859 DEVELOPMENT OF A SILVER ACTIVATED PHOSPHATE GLASS FOR DOSIMETRIC PURPOSES. Singh Nagpal, J. B. (Bhabha Atomic Research Centre, Trombay, India). pp 299-305 of Radiation Protection Monitoring. Vienna, International Atomic Energy Agency, 1969.

From Regional Seminar for Asia and Far East on Radiation Protection Monitoring, Bombay, India. See STI/PUB-199; CONF-681203.

A silver activated phosphate glass was successfully fused in the author's laboratory for dosimetry purposes. The response of this glass was found to be linear up to 1000 R for ^{60}Co gamma rays. The characteristics of this glass were compared with equivalent glasses of the Toshiba type and the locally fabricated glass was found to be satisfactory. Similar studies were also done for the X-ray and thermal-neutron response of these two glasses and the results are presented. This glass was developed principally for accident monitoring purposes. (auth)

47860 TLD SYSTEM FOR MEASUREMENT OF A WIDE RANGE OF X- AND GAMMA EXPOSURES. Gangadharan, P.; Balasubramanian, V.; Kale, L. R.; Sane, S. G.; Pendurkar, H. K. (Bhabha Atomic Research Centre, Trombay, India). pp 307-19 of Radiation Protection Monitoring. Vienna, International Atomic Energy Agency, 1969.

From Regional Seminar for Asia and Far East on Radiation Protection Monitoring, Bombay, India. See STI/PUB-199; CONF-681203.

The phosphor used in these investigations was locally prepared lithium borate (manganese activated). The read-out system consists of: (1) a platinum foil used as the heating element; (2) a multiplier phototube to measure the thermoluminescence output; (3) a dc amplifier; (4) a recorder to display the glow curves; (5) a timer to start and terminate the readings; and (6) a light source to serve as a calibration standard for the PM tube. This system has provided consistent response in the exposure range from 400 mR to 10^4 R and efforts are under way to reduce the threshold further. The read-out system is provided with a nitrogen flushing facility to eliminate the effect of non-radiation-induced signals during measurement. Studies of the various characteristics of the phosphor, such as energy dependence, exposure rate dependence, linearity and reproducibility have been made and the results are presented. (auth)

47861 RADIATION MONITORING WITH A NATURAL CALCIUM FLUORIDE THERMOLUMINESCENT DETECTOR. Nambi, K. S. V.; Kathuria, S. P.; Sunta, C. M. (Bhabha Atomic Research Centre, Trombay, India). pp 321-33 of Radiation Protection Monitoring. Vienna, International Atomic Energy Agency, 1969.

From Regional Seminar for Asia and Far East on Radiation Protection Monitoring, Bombay, India. See STI/PUB-199; CONF-681203.

A simple system for radiation monitoring that makes use of the thermoluminescent property of natural calcium fluoride powder is presented. It consists of a Kanthal strip on which a thin layer of thermoluminescent detector is deposited by means of a resin. The exposed dosimeter is read by directly heating it by passing a 30-A electric current through it for half a minute. The thermoluminescence glow is measured and recorded with a cooled low dark-current photomultiplier tube coupled with an electrometer dc amplifier and a recorder. Integrated exposures as low as 10 mR can be read without any inert gas atmosphere during reading. This system of dosimetry is used for both personnel and area monitoring in reactors and processing plants. Gamma and beta exposures received by the personnel in mixed fields during operations such as irradiated fuel handling are evaluated separately and compared with readings from other monitoring instruments. This system of monitoring is also being routinely used for environmental monitoring with a view to ensuring advance indication of any trend towards harmful build-up of radiation fields in the Bhabha Atomic Research Center due to normal operations carried out in its various plants and laboratories, and also to provide background information for use in radiation emergency operations. A representative set of data obtained in personnel, area and environmental monitoring is presented and compared with data obtained with conventional monitoring instruments. The problems of energy dependence, light sensitivity, thermal glow, fading, etc., as faced by the authors, are discussed. (auth)

47862 RADIOPHOTOLUMINESCENT DETECTORS, PARTICLE TRACK DETECTORS, AND LIQUID-FILLED IONIZATION CHAMBERS. Francois, H. (CEA, Fontenay-aux-Roses, France). pp 343-60 of Radiation Protection Monitoring. Vienna, International Atomic Energy Agency, 1969.

From Regional Seminar for Asia and Far East on Radiation Protection Monitoring, Bombay, India. See STI/PUB-199; CONF-681203.

Some of the more recently developed methods that are now beginning to replace the use of photographic film for measuring the radiation doses received by persons are reviewed. These methods are based on the use of radiophotoluminescent and radiothermoluminescent solids, ionographic tracks in insulating solids and ionization chambers filled with dielectric liquids. The characteristics of these devices and their responses to different types of radiation are reviewed, their applications to area and individual monitoring are summarized and their advantages and disadvantages are compared. It is emphasized that each device should be examined objectively while taking into account its distinctive features, its limitations and its ability to complement other devices in measuring the dose received in mixed radiation fields. (29 references) (auth)

47863 PERIODIC CHECKING OF DOSIMETRIC INSTRUMENTS. Yudin, M. F. (Mendeleev Inst. of Metrology, Leningrad). pp 373-91 of Radiation Protection Monitoring. Vienna, International Atomic Energy Agency, 1969.

From Regional Seminar for Asia and Far East on Radiation Protection Monitoring, Bombay, India. See STI/PUB-199; CONF-681203.

The basic radiological quantities and units specified in the most recent publication of the ICRU, particular attention being given to the dose-equivalent, are reviewed. The maintenance of primary standards and the development of national calibration services are discussed and consideration is given to general requirements for the calibration of X-ray dosimeters, gamma-ray dosimeters and gamma-ray sources. This is followed by a more detailed discussion of the calibration of specific X- and gamma-ray, alpha-, and beta-particle and neutron instruments. An analysis is made of the principal sources of error in the use of dosimetric instruments, including calibration errors, instability of the instrument and, in particular, differences between the conditions under which the instrument is calibrated and those under which it is used. The basic features of suitable calibration rooms and workshops for the maintenance and repair of instruments are summarized. (auth)

47864 PERSONNEL MONITORING IN INDIA. Nayyar, S. S.; Jain, V. K.; Singh Nagpal, J. B. (Bhabha Atomic Research Centre, Trombay, India). pp 393-406 of Radiation Protection Monitoring. Vienna, International Atomic Energy Agency, 1969.

From Regional Seminar for Asia and Far East on Radiation Protection Monitoring, Bombay, India. See STI/PUB-199; CONF-681203.

A multi-filter cassette designed and developed for personnel

monitoring of radiation workers is described. This cassette incorporates six filters; 1 mm Cd, 1 mm Pb, 1 mm Cu, 0.15 mm Cu, 1 mm plastic and open window. The aim of this multi-filter system is to identify the type or types of radiation to which a person is exposed and thus to avoid the normal errors encountered in film dosimetry because of the frequent absence of definite information on the quality of the incident radiation. The advantage of this multi-filter system is that it can be used for monitoring X-rays of all qualities, gamma rays, beta particles, and thermal neutrons. Experience has shown that the ready identification of the type or types of radiation to which a person is exposed is an extremely important step in limiting future exposures. The film used is the Kodak PM type 2, which incorporates two emulsions of widely different sensitivities, thus enabling the coverage of a wide range of exposures. The dose ranges covered by this system are 10 mrem to 1000 rem for gamma rays, 1 mrem to 50 rem for low-energy X-rays and 15 mrem to 1500 rem for beta particles. Thermal-neutron doses up to 200 rem can be measured by this system when such thermal-neutron exposures occur in conjunction with gamma exposure, as in a reactor environment. A separate Kodak type A film in a separate holder is used for estimating fast-neutron doses up to about 5 rem. Problems such as the minimum doses measurable, the accuracy of dose estimation, and dose estimations in cases of mixed radiation exposures, are discussed. The methods followed in the maintenance of dose records are also mentioned. The records have been analyzed to obtain the radiation dose per week per worker for each institution in India. Yearly data of institutions show a gradual lowering of the occupational exposure levels. (auth)

47865 TRANSISTORIZED DOSIMETER FOR FAST NEUTRONS IN THE RANGE 0.1 TO 15 MeV FOR THE REACTOR AND VAN DE GRAAFF FACILITIES AT THE BHABHA ATOMIC RESEARCH CENTRE. Veer Raj Urs, A. S. (Bhabha Atomic Research Centre, Trombay, India). pp 477-85 of Radiation Protection Monitoring. Vienna, International Atomic Energy Agency, 1969.

From Regional Seminar for Asia and Far East on Radiation Protection Monitoring, Bombay, India. See STI/PUB-199; CONF-681203.

The development and calibration of a fully transistorized dosimeter for fast neutrons in the range 0.1 to 15 MeV are described. The instrument makes use of a recoil proton counter as the fast-neutron detector. A standard Am-α-Be source ($Q = 1.1 \times 10^6$ n/s) was used for its calibration. Also, the possibility of calibrating the instrument to meet the latest recommendation of the ICRP is discussed. (auth)

Radiometric Instruments

Refer also to abstract 47631.

47866 (NIJS-P-244) MEASUREMENT OF DENSITY AND MOISTURE-CONTENT OF BUILDING MATERIALS. Zajc, A.; Jencek, D.; Hribar, M.; Milavc, Z.; Orel, A. (Nuklearni Institut Jozef Stefan, Ljubljana (Yugoslavia)). June 1969. 13p. (In Slavic). Dep. CFSTI (U. S. Sales Only).

An apparatus for the nondestructive measurement of density and moisture content of soil or other building materials was constructed. The apparatus is based on the known method of gamma-ray and neutron scattering. The continuous use of the instrument proved its usefulness for standard field measurements and research. At extensive earth-works on construction of a water channel at the hydroelectric plant HC Srednja Drava I near Maribor the instrument allowed the optimization of the material raising and compressing. The instruments used in field measurements and some results of wider interest are described. (auth)

47867 (NSJ-tr-146) NEW WELL LOGGING METHOD USING THE NEUTRON TUBE. Itoh, Toshinobu; Sekiguchi, Akira. Translated from Oyo Butsuri, 37: 322-33(Apr. 1968). 23p. Dep. CFSTI (U. S. Sales Only).

An abstract of this paper, prepared from the original language, appeared as NSA 22: 30886.

47868 (NSJ-tr-152) CONTINUOUS AND AUTOMATIC MEASUREMENT OF CALORIFIC VALUE OF HEAVY OIL BY THE USE OF NEUTRON. Miyashita, Kyoichi. Translated from Genshiryoku Kogyo, 13: No. 10, 52-5(1967). 12p. Dep. CFSTI (U. S. Sales Only).

An abstract of this paper, prepared from the original language, appeared as NSA 22: 30885.

47869 STUDY OF BETA-RAY BACKSCATTERING THICKNESS GAUGE. Hsu, Shang-shiang (National Tsing Hua Univ., Hsinchu, Taiwan). Ho Tsu K'o Hsueh, 6: No. 3-4, 123-9(Apr. 1969).

The backscattering of β-rays from gold, lead, tin, cadmium, copper, iron, aluminum and acrylic is described. A thickness gage based on the β-ray backscattering principle is proposed. The saturation counting rate of the thickness gage versus the atomic number of beta source backing material and that versus the coating aluminum thickness have been investigated. (auth)

47870 DEVICE FOR TESTING ELECTRIC-INSULATION PAINTS. Ogata, Hideto (to Japanese National Railways). Japanese Patent 1969-15472. July 9, 1969. Filed Apr. 4, 1966.

Smoke and dust attach to porcelain insulators for high-voltage electric wires and damage the insulating property of such insulators. To eliminate this damage and also to repel moisture, silicon grease is painted on the porcelain insulators. The proposed method is for testing such paints, and also investigating endurance of the paints on porcelain insulators. The powder of a radioisotope, such as ^{60}Co or ^{82}Br, emitting both beta- and gamma-rays, is sprinkled on the paint to be tested. The powder particles penetrate gradually into the paint. The electron-beam is attenuated correspondingly, but the gamma-ray is not. The count-rates of both the beta-rays and the gamma-rays are taken. For the electrons an end-window type counter is used, and for the gamma rays a scintillation crystal is used. From the ratio of the two count-rates, performance of the paint, associated with the powder-particle movement, is evaluated. (NSA of Japan)

Miscellaneous Instruments and Components

Refer also to abstracts 47687, 47692, 47791, 48314, 48974, 49541, 49582, and 49585.

47871 (AD-689829) DEVELOPMENT OF A MOLECULAR BEAM DETECTION SYSTEM AND VELOCITY SELECTOR. Final Report, November 1, 1966-October 31, 1968. Jordan, John E. (American Science and Engineering, Inc., Cambridge, Mass.). Mar. 28, 1969. Contract F19628-67-C-0068. 27p. (ASE-2217; AFCRL-69-204). CFSTI.

A multidisk velocity selector and an electron bombardment molecular beam detector have been constructed. The design and construction of the two units are described in detail. Their performance is discussed and suggestions for maintenance are made. (auth) (USGRDR)

47872 (BNWL-1158) EDDY CURRENT NONDESTRUCTIVE TEST TUBING CROSS-SECTION DISPLAY DEVICE. Libby, H. L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Aug. 1969. Contract AT(45-1)-1830. 15p. Dep. CFSTI.

Additional test results of an eddy current tubing cross-section display device described in an earlier report are given. The tubing cross-section display device gives a cathode ray tube presentation showing the approximate location of tubing flaws detected by the eddy current method. A multiparameter eddy current tester is used to provide the needed variety and separation of signals, and the method of display is similar to that used in a radar system plan position indicator. Signals resulting from artificial flaws within the tube wall have now been displayed. A composite photograph of the display shows the relative location of outer wall, within the wall, and inner wall artificial flaws in 0.080 in. wall, $3\frac{1}{16}$ in. O.D. type 304 stainless tube. Display circuitry for handling six signal channels has been built. (auth)

47873 (HASL-208) GROUND PLANE PRINTED CIRCUIT BOARDS BY REFRACTED PHOTOGRAPHIC METHOD. Wilson, F. (New York Operations Office (AEC), N. Y. Health and Safety Lab.). May 1969. 9p. Dep. CFSTI.

Ground plane printed circuit boards with insulated barriers etched around the conductors have been made from a simple line diagram of the conductor pattern by using refracted light to obtain a sharp image of the outline of the conductors. The line width is controlled by selection and manipulation of the light refractor. The refracted photographic method results in a considerable saving of drafting time in the preparation of the master for the ground plane printed circuit board. (auth)

47874 (IA-1183) CRITERION FOR COMPARING ANALYZERS. Sar-El, H. Z. (Israel Atomic Energy Commission, Tel Aviv). Jan. 1969. 17p. Dep. CFSTI (U. S. Sales Only).

In view of the recent development of several new electrostatic analyzers, the need arises for a criterion for comparing their figures of merit. A criterion usually used in β-spectrometry is proposed, with reservations, and is shown to be preferable to another criterion. (auth)

47875 (KFK-845) PICTURE ANALYSIS WITH THE QUANTIMET. Ondracek, G. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material- und Festkoeperforschung). Mar. 1969. 77p. (In German). Dep.

Separate abstracts were prepared for three of the seven papers presented. The remaining four papers were not within the scope of NSA. (W.H.K.)

For abstracts of individual papers see: 47733, 47845, and 48560.

47876 (NSJ-tr-150) TIME ANALYZER USING BINARY SCALERS. Hasegawa, Ken-ichi; Komorida, Katsuhiro; Nishino, Osamu; Sekiguchi, Akira. Translated from Nippon Genshiryoku Gakkaishi, 10: 313-18(June 1968). 12p. Dep. CFSTI (U. S. Sales Only).

An abstract of this paper, prepared from the original language, appeared as NSA 22: 38153.

47877 (NYO-1480-122) PROGRESS REPORT NO. 42 [ON COMPUTING AND APPLIED MATHEMATICS] FOR THE HALF YEAR JANUARY 1-JUNE 30, 1969. Technical Summary for Tasks I and V also Administrative and Financial Summary for Entire Contract. (New York Univ., N. Y. AEC Computing and Applied Mathematics Center). Sept. 8, 1969. Contract AT-(30-1)-1480. 18p. Dep. CFSTI.

Research in applied mathematics and mechanics, physics of many-particle systems, and computer operations and programming is outlined. (W.H.K.)

47878 (WCAP-3690-5) DEVELOPMENT OF A BORON CONCENTRATION METER. Technical Progress Report for the Period Ending March 31, 1968. (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.). Apr. 1968. Contract AT-(30-1)-3690. 35p. (EURAEC-2005). Dep. CFSTI.

Work Performed under United States-Euratom Joint Research and Development Program.

The increasing application of Chemical Shim Control to Pressurized Water Reactors (PWR's) has emphasized the need for a means to monitor accurately and automatically the concentration of boric acid in aqueous solution. The development, design, testing and evaluation of two prototype boron concentration meters are described. One meter under investigation is based on conductivity measurements of a boric acid solution with mannitol added. The second is based on the neutron absorption principle. (auth)

47879 (WCAP-3690-6) DEVELOPMENT OF A BORON CONCENTRATION METER. Technical Progress Report for the Period Ending June 30, 1968. (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.). Aug. 1968. Contract AT(30-1)-3690. 88p. (EURAEC-2042). Dep. CFSTI.

Work Performed under United States-Euratom Joint Research and Development Program.

The increasing application of Chemical Shim Control to Pressurized Water Reactors (PWR's) has emphasized the need for a means to monitor accurately and automatically the concentration of boric acid in aqueous solution. The development, design, testing and evaluation of two prototype boron concentration meters. One meter under investigation is based on conductivity measurements of a boric acid solution with mannitol added. The second is based on the neutron absorption principle. (auth)

47880 (WCAP-3690-7) DEVELOPMENT OF A BORON CONCENTRATION METER. Final Report. Bulkowski, J. E.; Fletcher, W. D.; Opitz, A. G.; Rajagopal, V.; Whyte, D. D. (Westinghouse Electric Corp., Pittsburgh, Pa. Nuclear Energy Systems Div.). Apr. 1969. Contract AT(30-1)-3690. 188p. (EURAEC-2094). Dep. CFSTI.

Work performed under United States-Euratom Joint Research and Development Program.

Two prototype meters for monitoring reactor coolant boron concentration were developed and evaluated. One meter employs the mannitol-conductance technique for determining boron concentration; the other employs the neutron-absorption technique. Both meters are capable of quickly determining boron concentration in the reactor coolant, and both may be operated continuously, if desired. The development, operation, evaluation of the prototype meters, and a description of each meter are summarized. (auth)

47881 DEVICE FOR PRODUCING ION BEAM. Shimizu, Daisaburo (to Hitachi Ltd.). Japanese Patent 1969-15835. July 8, 1969. Filed Oct. 18, 1965.

Gas is introduced into a discharge tube up to a suitable pressure. The gas is ionized by means of a high-frequency power applied to the tube. The ion beam is extracted by a positive voltage between the cathode and the canal electrode. The canal electrode is grounded through a resistance. (NSA of Japan)

47882 DEVISE FOR REDUCING THE RADIATION STRESS OF A ROENTGENOLOGIST IN ANGIOGRAPHY. Zakharov, B. I.; Kruchinina, E. G. Vop. Onkol., 15: No. 6, 97-8(1969). (In Russian).

A personnel protecting device enabling a remote control injection during x-ray angiography is described. The use of the device with the protective screen reduces the dose of radiation to the lower parts of the physician's body by a factor of 100 (or from 290 mc to 3 mc) without affecting the quality of the obtained radioangiograms. (R.V.J.)

47883 LIGHTING DEVICE USING RADIOACTIVE MATERIAL. Otomo, Yoshiro (to Hitachi Ltd.). Japanese Patent 1969-12948. June 10, 1969. Filed Dec. 22, 1964.

In the lighting device proposed, radiation from a radioactive gas excites a fluorescent material which emits light. The gas is contained in a semicircular chamber, the light-emitting material is painted on the inside surface of the chamber wall, and the light produced flows out through the window covering the semicircular chamber. The method has the advantages of using a small amount of radioactive gas, and high light-emitting efficiency. Instead of the usual configuration, which is a convex, semi-circular light reflecting surface with fluorescent material painted on it, the following types are used: (1) parallel transparent plates or rods, if desired, in the form of a grid, protruding from the semi-circular surface and reaching the cover window in front; (2) arrangement of transparent fibers in the form of a cobweb to serve as the luminous surface, in addition to the semi-circular surface; and (3) comb-like or saw blade-like protrusions from the semi-circular surface. Furthermore, in the case of (1), the parallel plates or rods are made of the same material as the window, or have the same refraction index as the window. (NSA of Japan)

47884 UNIVERSAL ACTIVIMETER. Pathol. Biol., Sem. Hop., 15: 1249-50(Dec. 1967). (In French).

Characteristics of a transistorized automatic sample changer for measurement of β and γ irradiations were described. The efficiency of the equipment for ^{14}C was 35%, and the background was less than 0.5 cpm. The high voltage range extended up to 5000 V. The capacity could be expanded to 160 samples. Resolution time was 3.5 μsec and the amplifier gain was 1000. A printout mechanism to record counts to the nearest 0.1-sec interval was supplied with the instrument. (BBB)

47885 NUCLEAR DATA SYSTEM. Bromley, D. A. (Yale Univ., New Haven); Sachs, M. W.; Birnbaum, J. S. Rev. Phys. Appl., 4: 116-8(June 1969).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

A collaborating group of Yale and IBM scientists have developed a versatile data acquisition system, based on an IBM system/360 Model 44 Computer, which is now in routine use. Data acquisition is performed via an interface which features modular and digitally compatible ADCs, scalers and monitor registers, and which allows the experimenter to define up to sixteen independent events. The software system makes possible the processing of all incoming events by FORTRAN programs. Communication between the experimenter and computer is carried out by means of a display terminal which includes a 1024-1024 random point plotting CRT with a built-in character generator, and a function keyboard. Facilities are also included for control and monitoring of the experiment hardware and accelerator conditions. A multiprogramming supervisor enables several independent jobs to be run simultaneously, with inter-job communication facilities to enable analysis of data to be carried out concurrently with its acquisition. (auth)

47886 ANALOGIES OF METHODS AND DIFFERENCES IN APPARATUS IN ACQUISITION OF CORRELATION DATA. Ballini, R. (Service de Physique Nucleaire a Basse Energie, Saclay, France); Festa, E.; Fouan, J. P.; Kamoun, R.; Picard, F.; Rosenbaum, B. Rev. Phys. Appl., 4: 119-20(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

The acquisition of data from particle correlation experiments (α,γ), $(^3He,d\gamma)$, $(d,p\gamma)$, $(p,p'\gamma)$, and polarization experiments, has been carried out by means of different types of system, one based on hardware and others based on an on-line computer. Critical examination of each set-up leads to similar conclusions. (auth)

47887 MEASUREMENT OF THE POLARIZATION OF NEUTRONS DURING EXPERIMENTS. Delpierre, P.; Heyman, M.; Kahane, J.; Sene, R.; Saget, G. Rev. Phys. Appl., 4: 254-6(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

To measure the 14 MeV neutron polarization during scattering

experiments, a gas polarimeter was constructed. To reduce the duration to a value small compared to that of the experiment in progress, the helium was compressed at 150 bars in a volume of 300 cm^3 and disposed as near to the source as possible. (auth)

47888 HIGH-VOLTAGE FAST PULSE GENERATORS WITH SPARK GAPS. Schmitt, F.; Gresser, J.; Metzger, G.; Riedinger, M.; Sutter, G. (Institut de Recherches Nucleaires, Strasbourg). Rev. Phys. Appl., 4: 221-2(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

High-voltage pulse generators in the 5 to 600 kV region yielding fast risetime, small delay, negligible jitter, and perfect reproducibility are described. (auth)

47889 FAST CIRCUITS USING TRANSISTORS IN THE AVALANCHE MODE. Metzger, G.; Schmitt, F.; Riedinger, M.; Gresser, J.; Sutter, G. (Institut de Recherches Nucleaires, Strasbourg). Rev. Phys. Appl., 4: 223-4(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

Fast circuits are described using transistors in the avalanche mode: (i) trigger: sensitivity 10 mV, delay 3 ns, nanosecond risetime, amplitudes from a few volts to about one hundred volts; (ii) coincidence circuit: nanosecond resolving time; (iii) high voltage generator: 3.6 kV, delay 10 ns, risetime 10 ns. (auth)

47890 RANDOM NUMBER GENERATOR. Bilwes, R.; Bueb, B.; Juniot, P.; Ring, C. (CRN, Strasbourg). Rev. Phys. Appl., 4: 228(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

This random-generator uses the statistical distribution of nuclear disintegrations. It consists of 16 G-M counters put around a radioactive source, connected through 16 flip-flops to a digital input of an IBM 1800 computer. It can be used for Monte Carlo calculations. (auth)

47891 EXPERIMENTAL STUDIES ON A MAGNETIC PRISM. Camplan, J.; Meunier, R. (CNRS, Orsay, France). Rev. Phys. Appl., 4: 214(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

Two experimental methods concerning a magnetic prism are described. They lead: the first one to (i) the field indexes; (ii) the determination of shims; the second one to an entrance profile which reduces the image width. (auth)

47892 DATA ACQUISITION PROGRAM. Faivre, J. C.; Escudie, J. L. (CEN, Saclay, France). Rev. Phys. Appl., 4: 131-2(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

A 64,000 channel acquisition program has been written for the CII 90-10 (SDS 92) computer. This program uses the associative memory methods and includes particle identification. The counts per channel are permanently stored in the mass memory (disk). (auth)

47893 LANGUAGE AND SOFTWARE SYSTEM FOR NUCLEAR EXPERIMENTS. Beauval, Y.; Delbreil, J. P.; Chardenon, J. P.; Meinadier, J. P. (CEN, Saclay, France). Rev. Phys. Appl., 4: 133-4(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

A software system for small computers is described. It allows an interpretative language for pulse height analysis that can be used in a conversational way as well as in a programmed way. (auth)

47894 APPLICATION OF TWO PDP 8 COMPUTERS IN EXPERIMENTS REQUIRING REAL TIME PREANALYSIS AND CONCURRENT DATA ANALYSIS. Chaminade, R.; Pain, J.; Lechaczynski, M.; Faivre, J. C.; Demeuzois, J.; Durruty, J. (CEN, Saclay, France). Rev. Phys. Appl., 4: 135-6(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

The use of two PDP 8 and a multichannel analyzer in two different types of experiment requiring real time preanalysis and concurrent data analysis is described. For example: particle nature identification in real time by computer in nuclear spectroscopy with a solid state detector telescope. Redundancy is provided in real time work. (auth)

47895 ANALYSIS OF EXPERIMENTS IN LOW-ENERGY NUCLEAR PHYSICS. Daronian, D.; Veyrie-Faucon, A. (CEN, Saclay, France). Rev. Phys. Appl., 4: 137-8(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

A nuclear handling system built around a CAE 510 computer is described. Two kinds of experiments, processed by this system, are shown so that one can demonstrate the importance of the display unit and of the plotter in connection with the computer. (auth)

47896 SYSTEM FOR DATA ACQUISITION AND PROCESSING IN REAL TIME. Merchez, F.; Tournier, M. (Institut des Sciences Nucleaires, Grenoble, France). Rev. Phys. Appl., 4: 139-40(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

The results of the $^6Li(n,p)$ experiment are analyzed in real time by a data acquisition and processing system. Constructed in the laboratory with standard devices this system, characterized by a great flexibility of utilization is specially interesting for low acquisition rates. (auth)

47897 ANALYSIS OF SPECTRA WITH THE AID OF AN IBM 1800 COMPUTER. Wery, M.; Wittmer, P.; Bueb, B.; Ring, C.; Suffert, M.; Magnac-Valette, D. (CRN, Strasbourg). Rev. Phys. Appl., 4: 140-1(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

A short description of a system for data analysis of low-energy experiments is given. Good communication between the user and the computer improves speed and accuracy of the analysis. (auth)

47898 DATA ACQUISITION AND PROCESSING BY AN IBM 1800 SYSTEM. Zen, J.; Muser, A.; Michaud, J. D. (Institut de Recherches Nucleaires, Strasbourg). Rev. Phys. Appl., 4: 142-3(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

An on-line data acquisition and processing system using an IBM 1800 computer is described. This system allows several research teams to use simultaneously the computer for data acquisition and processing in real time. (auth)

47899 SAMPLING FOR SIMULTANEOUS ANALYSIS OF EVENTS X, Y, AND XY. Muser, A.; Zen, J.; Michaud, J. D.; Scheibling, F. (Institut de Recherches Nucleaires, Strasbourg). Rev. Phys. Appl., 4: 143-4(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

In a bidimensional analysis, it is often necessary to know together with the XY spectrum, the two single X and Y spectra. It is important to use the same converters for both types of spectra. The resulting increase of dead time may be limited using a sampling method. The principle of the method is discussed and the logic of the electronic circuitry is described. (auth)

47900 VISUALIZATION AND DISPLAY OF SPECTRA REGISTERED IN AN IBM 1800. Muser, A.; Zen, J.; Michaud, J. D. (Institut de Recherches Nucleaires, Strasbourg). Rev. Phys. Appl., 4: 145-6(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

The software visualization needs too much time to rewrite the data tables in the acquisition mode. We have developed a hardware-software visualization system which permits simultaneously data acquisition, processing and display. A hardware visualization increasing the size of the area available for the data processing is described. (auth)

47901 ACQUISITION, VISUALIZATION, AND ANALYSIS SYSTEM ON-LINE TO SIMULTANEOUS EXPERIMENTS. Brun, J. C. (Institut de Physique Nucleaire, Orsay, France); Faucher, L.; Adam, J. P. Rev. Phys. Appl., 4: 147-8(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

The computer system set up at Orsay is designed to control simultaneously several independent experiments made in different places. An acquisition channel can be conventional nuclear physics equipment. The remote stations are equipped with a typewriter, a visual display (television), and an associated light-pen. (auth)

47902 CONSTRUCTION OF HISTOGRAMS OF VERY LARGE DIMENSION ON A MAGNETIC DISK. Adam, J. P. Rev. Phys. Appl., 4: 149-50(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

A program allowing one to build on-line or off-line large histograms of up to 3×10^6 channels using disk units of an IBM 360/50 computer is described. A simple data structure on the disk simplifies the post-processing and the display of such histograms. The performance lies between a few hundred and 2000 events per sec. (auth)

47903 S.A.G.E.: ACQUISITION AND MANAGEMENT SYSTEM FOR EXPERIMENTS. Brisson, J. C.; Kony, J.; Rousseau, J. M. (CEN, Saclay, France). Rev. Phys. Appl., 4: 150-2(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

S.A.G.E. is an automatic data acquisition device including a small computer to give high energy physicists a powerful tool. (auth)

47904 PULSE ANALYZER SYSTEM WITH HIGH RESOLUTION AT HIGH COUNTING RATES. Avril, M.; Delaittre, B.; Hameau, P.; Labrely, J.; Moreau, R.; Pages, A.; Vidal, M. (CEN, Saclay, France). Rev. Phys. Appl., 4: 153-4(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

The characteristics and performance of the elements of a new amplifying system are reported here. The principal features of the construction are a very good resolution even at a relatively high counting rate (2×10^5 counts/sec) and the possibility of knowing after each measurement the total number of pile-up losses. (auth)

47905 IMPROVEMENT OF THE ON-LINE ACQUISITION BY THE CAE 510 COMPUTER. Cauvin, B.; Huet, M.; Sanche, M. (CEN, Saclay, France). Rev. Phys. Appl., 4: 124-6(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

Improvements of a program for data acquisition of information coming from neutron time of flight experiments are discussed. This program, written for the CAE510 computer (this computer does not permit direct access to the memory), is designed to permit execution of the main program with periodic interruption for data acquisition. (auth)

47906 DATA ACQUISITION ON MAGNETIC TAPE COMPATIBLE FOR PROCESSING. Signarbieux, C.; Ribrag, M.; Richard, J. P. (CEN, Saclay, France). Rev. Phys. Appl., 4: 127-8(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

A recent system of statistical multiparametric data acquisition on magnetic tape is described. The buffer store can accommodate 72 digits at most. The use of an incremental magnetic recorder allows one to obtain a computer magnetic tape directly and to improve by a factor 30 the acquisition rate of classical paper tape punchers. (auth)

47907 STRETCHED REFERENCE WIRE MAGNETIC PICK-UP ALIGNMENT SYSTEM. Panofsky, Wolfgang K. H.; Marshall, William F. (to United States Atomic Energy Commission). U. S. Patent 3,470,460. Sept. 30, 1969.

A system for indicating physical alignment of an object with respect to a stretched reference wire to which an alternating current signal is continuously applied is described. Window-type pickup magnets for pickup of the signal are mounted at sensing stations on the object. Initially, the object is placed in alignment by other means. Thereafter, any transverse movement of the object causes movement of the pickup magnets away from their centered position. Upon being even slightly off-centered, signals are induced from the reference wire to the magnets. The magnet windings are connected to produce a resultant signal that may be rectified to a direct current signal. The level of the direct current signal corresponds to the amount of misalignment of the object, which its polarity corresponds to the direction of misalignment. The system is specifically designed for continuous alignment of the magnets of a beam analyzing spectrometer for a linear accelerator. (AEC)

47908 ELECTROSTATIC PRECIPITATOR FOR QUICK ESTIMATION OF THE CONCENTRATION OF ^{239}Pu IN AIR. Mehta, S. K. (Bhabha Atomic Research Centre, Trombay, India). pp 237-41 of Radiation Protection Monitoring. Vienna, International Atomic Energy Agency, 1969.

From Regional Seminar for Asia and Far East on Radiation Protection Monitoring, Bombay, India. See STI/PUB-199; CONF-681203.

An electrostatic precipitator air sampler has been developed for the quick estimation of ^{239}Pu concentration in air. The nonlinear charging of aerosol particles (with respect to particle size) in a corona discharge is used to obtain efficient precipitation for ^{239}Pu dust (particle size 0.5 μm and above), eliminating excessive background activity from short-lived decay products of radon and thoron, which is associated with dust particles less than 0.04 μm in size. The aerosol is precipitated by passing it through a corona discharge maintained between a 2-in. diameter metal planchet and 19 sharply pointed electrodes. The planchet is easily counted in a ZnS alpha scintillation counter. Precipitation efficiency of 83% is obtained for plutonium dust when the air-flow rate is 100 litres/min, and 65% of the short-lived activity is eliminated. (auth)

47909 ^{88}Rb COLLECTING EFFICIENCY OF CHAMBERS FOR ^{88}Kr RADIOMETRY BY ^{88}Rb. Bochkov, A. L.; Kornilenko, I. I.; Obaturov, G. M. At. Energ. (USSR), 27: 66-7(July 1969). (In Russian).

The ^{88}Rb collecting efficiency of I, II, and III type chamber for ^{88}Kr radiometry by ^{88}Rb was determined by comparing their efficiency with independently measured electrical ion collecting chamber. The dimensions and efficiency of the chambers are tabulated. (R.V.J.)

47910 METHOD OF INVESTIGATION OF ENERGY SPECTRUM OF ELECTRONS RELEASED FROM ATOMIC COLLISIONS. Ogurtsov, G. N.; Flaks, I. P.; Avakyan, S. V. (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Tekh. Fiz., 39: 1293-1301(July 1969). (In Russian).

A cylindrical electrostatic lens of high resolution and luminosity was used. A wire-mesh external electrode was used to decrease parasitic effects from secondary electrons. Electron ejection angles and focusing characteristics were studied. (tr-auth)

47911 ULTRASONIC INCIPIENT BOILING DETECTOR (July 1968) (Engineering Materials). (New York Operations Office (AEC), N. Y.). (CAPE-1921).

9 drawings.

The operation of this ultrasonic instrumentation, which is used for detecting the onset of boiling in liquid metals, is based on the ultrasonic power required to induce cavitation in the liquid, and is essentially independent of the temperature and pressure in the liquid metal. The instrument consists of a 50 kHz magnetostrictive transducer-coupling system, driving through a 25 in. waveguide rod, which terminates in a tapered transition coupler and a thin rectangular sensing plate. In reactor application, driving and pick-up transducers can be located outside the reactor shield with acoustic conductors inserted through acoustic isolation mounts. (For details see TID-4100, Suppl. 55) (See also 23: 14082) (F.S.)

Radiation Effects on Instruments and Instrument Components

Refer also to abstract 48975.

47912 SCINTILLATION RESPONSE OF THIN ZnO:Zn PHOSPHOR REGIONS TO EXCITATION BY HEAVY IONS. Lao, Q. H. (State Univ. of New York, Stony Brook); Hastings, L.; Finney, N.; Van Wijngaarden, A. Radiat. Eff., 1: 89-93(Apr. 1969).

Local regions on the surface of a sample of ZnO:Zn phosphor were deteriorated by low-energy heavy ions to a depth of a few hundred Angstrom units. These regions behave as "thin films" in which a negligible small amount of light is produced when an energetic projectile passes through it. The sample was then scanned across energetic ion beams. The scintillation response diminished when the beam impinged onto a film. The decrease ΔL, in light intensity is the amount of light produced in a phosphor region whose thickness is equivalent to the film thickness. For ^{1}H and ^{4}He, the luminescent efficiency, ΔL/ΔE (the ratio of the light produced to the observed energy loss), is approximately independent of energy indicating that the scintillation response depends primarily on the inelastic projectile-electron collisions rather than the elastic projectile target atom encounters. At a given velocity, a plot of ΔL versus the atomic number of the projectile exhibits oscillatory structure for which a tentative explanation is suggested. (auth)

47913 LUMINESCENCE OF ZnS/Cu LUMINOPHORS AFTER PROTON EXCITATION. Scharmann, A.; Wegner, U. (Univ., Giessen, Ger.). Z. Angew. Phys., 27: 293-9(Aug. 7, 1969). (In German).

Decay times of the blue and green bands of hexagonal and cubic ZnS/Cu powders were measured after proton-excitation. As

parameters, period of excitation pulse, temperature, and luminescence damage of the luminophor were changed. The influence of trap filling on decay times by uv-excitation and the luminescence damage of the two ZnS-modifications have been investigated. Equipment was tested for the excitation of ZnS/Cu crystals. The results are discussed with respect to an existing model. (auth)

47914 EFFECT OF NUCLEAR COLLISIONS ON THE LINEARITY OF SEMICONDUCTOR DETECTORS. Siffert, P.; Forcinal, G.; Coche, A. (Centre de Recherches Nucleaires, Strasbourg). Rev. Phys. Appl., 4: 275-7(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

The pulse height defect due to nuclear collisions is measured for ^{4}He, N, Ne ions (30 to 150 keV) impinging on a gold-silicon surface barrier detector. The results are compared with Lindhard's theory and are in good agreement. (auth)

47915 INFLUENCE OF NEUTRON BOMBARDMENT ON DIRECT CURRENT OF SILICON MESA-DIODES. Korshunov, V. D.; Kostyuchenko, E. A. Izv. Vyssh. Ucheb. Zaved., Fiz., No. 2, 117-19(1969). (In Russian).

The effects of fast neutrons on silicon mesa-diodes are considered. Specific features of the designs of the diodes studied include removal of the phase significance of the p–n transities. The role of the initial part of the volt–ampere characteristic of the diodes in increased radiation stability is discussed. The main cause of the decrease in the direct current of the mesa-diodes studied is the increased resistance of the diode base on neutron bombardment. (M.C.G.)

LIFE SCIENCES

Biochemistry, Physiology, and Molecular Biology

47916 AN EPR STUDY OF LIVE AND DEAD DROSOPHILA ADULTS UNDER AEROBIC CONDITIONS. Duke, P. S. (Coll. of Medicine, Omaha). Exp. Gerontol., 3: 335-40(Dec. 1968).

Drosophila were studied in a special holder under aerobic conditions, live and dead, at room temperature, by Electron Paramagnetic Resonance Spectroscopy. Two signals were observed, a strong one due to melanin and a very weak signal possibly due to peroxyl, that was enhanced by ascorbic acid and observed only in live flies. No signals were observed relating to ascorbyl, mitochondrial, 2-naphthylamine, or BHT radicals in vivo, or from chitin alone. (auth)

47917 REPLICATION OF PHAGE LAMBDA DNA. Tomizawa, Jun-ichi; Ogawa, Tomoko (National Inst. of Health of Japan, Tokyo). Cold Spring Harbor Symp. Quant. Biol., 33: 533-52 (1968).

From 33rd Cold Spring Harbor Symposium, Cold Spring Harbor, N. Y. See CONF-680631.

Replicating phage DNA molecules were isolated after preparing molecules of buoyant densities distinct from those of unreplicated and replicated phage DNA molecules as well as those of bacterial DNA molecules and then separating them by their difference in density. Escherichia coli grown in a heavy medium [in which H_2O was replaced by D_2O and $(^{14}NH_4)_2SO_4$ by $(^{15}NH_4)_2SO_4$] was infected with λ phage prepared in a light medium, and the infected cells were incubated in the heavy medium. The DNA was analyzed by CsCl density-gradient centrifugation. The infecting phage DNA molecules were light, the molecules replicated once were half heavy, and the bacterial DNA was heavy. Depending on the extent of replication of phage DNA, the replicating molecules had intermediate densities. By differential labeling, newly synthesized ^3H strands could be separated from the parental ^{32}P strands. The size of ^3H strands reflected the extent of replication of the molecules from which they were derived. Molecules that showed greater changes in density carried longer ^3H strands. Results showed that infecting DNA molecules circularize very fast. During the adsorption period and the first few minutes of the incubation time, practically all the molecules circularize by covalent closure of at least one of the strands of the molecules. These results together with the electron microscopic observation that the replicating λ DNA molecules, even those with short replicated regions, are circular indicate that replication of λ DNA molecules is initiated on a circular structure. (BBB)

Basic Processes

Refer also to abstracts 47387, 47388, 48104, 48156, 48167, and 48225.

47918 (TID-25136) DEVELOPMENT OF SOME RADIOISOTOPE PROCEDURES FOR MEASURING WATER MOVEMENT IN TREES. Owston, Peyton W.; Smith, James L.; Halverson, Howard G. (Forest Service, Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station). Apr. 22, 1969. Contract AT(49-11)-2773. 55p. Dep. CFSTI.

Water transpired by trees greatly reduces the water yield from forested watersheds. An attempt was made in the Sierra Nevada of California to quantify this passage of water through individual trees by means of radioactive tracers. Initial experiments were conducted with lodgepole pine (Pinus contorta Dougl.) and red fir (Abies magnifica A. Murr.) during different seasons of the year. Phosphorus-32 was injected into standing trees through small lateral roots. Isotope movement was followed in two ways: The path of movement was monitored outside the bark with a portable scintillation detector, and the cross-sectional pattern of movement was determined by autoradiographing transverse discs of stems. Rates of daytime isotope movement for both species ranged generally from 20 to 70 cm/hr during the summer. Winter movement averaged 0.3 to 1.3 cm/hr in red fir. The fastest rates of upward ascent, 1.5 to 2.0 m/hr, were measured in early spring when as much as 12 feet of snow lay on the ground. Most of the movement occurred in the outer few centimeters of sapwood, but some radioactivity was found at a depth of 6 to 8 cm at times of rapid ascent. (auth)

47919 RADIOISOTOPE METHOD FOR QUANTITATIVE DETERMINATION OF MINERAL CONTENT OF BONES. Rassow, J.; Strueter, H.-D. (Ruhr Univ., Essen). Fortschr. Geb. Roentgenstr. Nuklearmed., 111: 155-63(Aug. 1969). (In German).

The fundamental advantages of the single isotope method are retained by the double isotope procedure; these are elimination of geometric scatter, a high degree of accuracy that can be expressed mathematically, and optimal conditions of measurements. The accuracy of estimating mineral concentration can be increased by simultaneous absorption measurements using two isotopes. The error in measurement can be calculated and this is illustrated by means of diagrams and tables. Details of the technique and the practical application of both isotope methods are given. (auth)

47920 INTERPRETATION OF TRACER DATA: SIGNIFICANCE OF THE NUMBER OF TERMS IN SPECIFIC ACTIVITY FUNCTIONS. Mann, Jonah; Gurpide, Erlio (Columbia Univ., New York). Biophys. J., 9: 810-21(June 1969).

The number of terms in the specific activity function of a pool, following the introduction of an isotope tracer into a system of interconnected pools, can be smaller than the number of pools in the system, and this number cannot be determined from the number of exponential terms in the specific activity function of a pool. However, some information is conveyed by the number of exponential terms. The information is different depending upon whether the data are obtained from the pool into which the tracer is introduced or from another pool. In the latter case, the number of exponential terms is shown to indicate the maximum number of intermediate pools involved in the shortest path of transfer of material from the injected pool to the pool in question. With regard to the former case, this analysis is restricted to functions with two exponential terms and shows which systems of n pools ($n \geq 2$) are consistent with such data. Consequently, biexponential experimental curves can be interpreted in terms of models consisting of an unrestricted number of pools in which each pool is defined in terms of fast mixing. The generalization to cases of functions with more than two exponential terms can be carried out in a similar manner. (BBB)

47921 THE EFFECT OF CYANIDE, SERUM, AND OTHER FACTORS ON THE ASSAY OF VITAMIN B_{12} BY A RADIOISOTOPE METHOD USING $^{57}CoB_{12}$, INTRINSIC FACTOR AND COATED CHARCOAL. Raven, J. L.; Robson, M. B.; Walker, P. L.; Barkhan, P. Guy's Hosp. Rep., 117: 89-109(1968).

Some factors that influence the assay of vitamin B_{12} in serum and pure solutions were studied by a radioisotope dilution method employing $^{57}CoB_{12}$, intrinsic factor and coated charcoal. It was found that: Serum increased the B_{12}-binding capacity of intrinsic factor solutions under the conditions of the assay. The presence of serum improved the accuracy of assay of crystalline B_{12} solutions when an intrinsic factor control was used but was not necessary if a dilution curve was used for calculating the results. Unless cyanide was present, falsely low values were obtained both for hydroxocobalamin solutions and for sera with B_{12} concentrations exceeding 450 to 600 pg/ml. Accurate and comparable results were obtained for serum B_{12} values when either an intrinsic factor control or a dilution curve was used for calculating the results provided that the dilution curve was constructed from dilutions of crystalline cyanocobalamin solutions. Autoclaving rather than boiling in a water bath for the extraction process permitted the use of a common serum background control. This simplified the method by reducing the number of manipulations and also the number of tubes for counting. As a result of these observations, an improved radioisotope method for serum B_{12} determination was evolved. (auth)

47922 RADIOPROTECTIVE EFFECTS OF REDUCED GLUTATHIONE. TURNOVER OF ^{35}S-REDUCED GLUTATHIONE. Kiyono, Kunihiro; Sakamoto, Yoshio (Shinshu Univ., Matsumoto, Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 28: 1642-6 (Mar. 1969). (In Japanese).

Studies on the clearance rate and distribution of injected reduced glutathione were performed using radioactive ^{35}S-reduced glutathione ($G^{35}SH$). Intravenously injected $G^{35}SH$ concentrated in the kidney, adrenal, lung and spleen in mice. The blood level of $G^{35}SH$ decreased one fourth or fifth at fifteen or twenty minutes compared to five minutes after intravenous injection and remained constant over twenty four hours in mice. In the dog, however, it was one half at 30 min after intravenous administration of $G^{35}SH$. About fourteen or twenty minutes after intravenous injection of $G^{35}SH$, the radioactivity in the organs or tissues increased in contrast to the decrease of blood activity and maintained a high content of $G^{35}SH$ over two hours. The turnover of $G^{35}SH$ differ according to the spe-

cies animals and method of administration. The radioprotective mechanisms of reduced glutathione were briefly discussed. (auth)

Metabolism, Physiology, and Toxicology

Refer also to abstracts 47407, 48007, 48033, 48034, 48037, and 48095.

47923 (NSJ-tr-153) ON THE DIFFERENCE IN ^{86}Rb AND ^{32}P UPTAKE AT DIFFERENT ZONES OF THE RICE ROOTS. Yoshida, Takehiko; Nakamura, Masaharu. Translated from Nippon Dojo Hiryogaku Zasshi, 39: No. 5, 253-7(1968). 10p. Dep. CFSTI (U. S. Sales Only).

Using the excised roots of rice seedlings ^{86}Rb and ^{32}P uptake at the different zones were investigated in relation to whether they were metabolic or non-metabolic. In the uptake by rice roots, the zone of active absorption of salts is not restricted to the root tips, but it moves as the root grows or develops. The nature of this movement is complicated. On the whole, it is controlled by the age variation in the relative dominance of the three characteristic zones. The non-metabolic uptake by root tips was observed only for ^{86}Rb in young roots. The uptake of ^{86}Rb in mature roots, and of ^{32}P at all ages, being sensitive to low temperature and respiratory inhibitors, apparently depended on the metabolism. The significance of the age of roots in the absorption of salts was shown from the movement of the absorption peaks and the dependence on metabolism. (auth)

47924 (UH-235-P-8-X-2) PROGRESS REPORT, SEPTEMBER 1, 1968-AUGUST 31, 1969. Casarett, Louis J. (Hawaii Univ., Honolulu. School of Medicine). May 15, 1969. Contract AT(04-3)-235. 9p. Dep. CFSTI.

Studies on collection and evaluation of quantitative particle size data were conducted on ^{238}Pu, ^{239}Pu, and ^{235}U in tissues of dogs and rats. Data were collected for four distinct distributions, size, area, volume, and a combined rectified distribution. Experiments on the response of the pulmonary phagocytic system of mice to total inhaled dust load were conducted. Peritoneal macrophages were used for studies on kinetics of phagocytosis. These studies have implications for rates and mechanisms of clearance in the lung and on the subsequent distribution of the radiation dose from radioactive particle inhalation. Phagocytosis was enhanced by calcium ions, polyamino acids, uranyl and thoranyl ions. Studies on alveolar macrophages using Cr_2O_3 particles showed that interdependence of phagocytosis on the relative particle and cell concentrations was the same as that for peritoneal cells. Physiological responses that might influence the deposition or retention patterns of inhaled materials or might be an etiologic stage in the development of pulmonary pathology from inhaled radioactive materials were studied. (H.L.W.)

47925 CORRELATION OF PROSTATIC BLOOD FLOW WITH ^{65}Zn ACTIVITY IN INTACT, CASTRATED, AND TESTOSTERONE-TREATED BABOONS. Schoonees, R. (Univ. of Stellenbosch, S. Afr.); de Klerk, J. N.; Murphy, G. P. Invest Urol., 6: 476-84(Mar. 1969).

The uptake of ^{65}Zn by the baboon prostate gland was studied after injection of 100 μCi of $^{65}ZnCl_2$ intravenously. The prostate of Papio ursinus, or the Chacma baboon, consists of two anatomically well-defined portions which differ structurally and functionally. The caudal portion concentrates intravenously injected ^{65}Zn to a greater extent than the cranial portion. The prostatic ratio as determined by dividing prostatic wt (g) by the body wt (Kg) in the baboon increases rapidly with an increase of total body wt over 10 Kg. Maturity was associated with a high prostatic ^{65}Zn uptake ability and a high prostatic ratio. Prostatic blood flow rate can be determined by the rate of radioxenon clearance and was found to be greatly increased by exogenous testosterone treatment. Castration decreased the ^{65}Zn-concentrating ability of the caudal prostate. Exogenous testosterone treatment increased the uptake of both portions of the prostate, but in the caudal portion to the greatest degree. The results indicate the differences in regional prostatic activity, and demonstrate to what degree prostate blood flow and glandular ^{65}Zn-concentrating ability can be correlated in a subhuman primate. (BBB)

47926 UPTAKE AND EXCRETION OF ^{134}Cs FROM FALLOUT SIMULANT AND VEGETATION BY COTTON RATS. Kitchings III, J. T.; Dunaway, P. B.; Story, J. D. (Oak Ridge National Lab., Tenn.). Health Phys., 17: 265-77(Aug. 1969).

Cesium-134 tagged simulants with varying in vitro nuclide solubilities were analyzed with respect to absorbabilities of the ^{134}Cs by the gastrointestinal tract of cotton rats. Analysis of fecal material showed a rapid increase in radioactivity until the 42nd hr postadministration. Complete passage of the particulate matter was assumed to have occurred by the 66th hr. The elimination coefficients (λ_b) and biological half-lives (T_b) of the ^{134}Cs absorbed from the various simulants were: (1) 0.76%/hr, 3.79 days; (2) 1.16%/hr, 2.50 days; (3) 1.46%/hr, 1.98 days. The second experimental phase was to establish uptake rates and equilibrium levels for ^{134}Cs in laboratory-born and wild-trapped cotton rats under chronic ingestion conditions, using ^{134}Cs tagged lettuce as simulated contaminated vegetation, and to determine retention curves for ^{134}Cs following termination of the chronic ingestion regimen. The ^{134}Cs uptake for both groups appeared to be a multicomponent curve. Equations for uptake in the first and second components are given. The second component began at hour 208 and continued until hour 544. After the 544th hr the rate increase was so slight that it was considered to be zero. While the rate increase of both groups was not different, the amount of ^{134}Cs absorbed by the wild-trapped and laboratory-born groups showed a significant difference by the 64th hr. Retention curves, using the equilibrium levels as 100% incorporated ^{134}Cs, broke down into two components. Retention equations and biological half-lives for the first component (day 1 through 7), considered to be representative of systems such as the liver and intestinal tract, are given. The second component (days 8 through 35) is believed to be indicative of the longer retention compartments, such as muscle, and equations and half-lives are also given for this component. Accumulation and loss of ^{134}Cs was slowest in muscle. It appears that the type of material ingested and the method of ingestion, acute (simulant particles) vs chronic (vegetation), influenced the metabolic kinetics of ^{134}Cs under laboratory conditions. Presumably the cesium T_b was shorter in animals receiving a single dose of simulant because less cesium was incorporated in systemic compartments with slow uptake and long retention times. (auth) (UK)

47927 PHYSICOCHEMICAL STATE AS A DETERMINANT OF ^{238}Pu TOXICITY IN THE RAT. Mahlum, D. D.; Sikov, M. R. (Battelle Memorial Inst., Richland, Wash.). Health Phys., 17: 346-7(Aug. 1969).

It is stated that although ^{238}Pu and ^{239}Pu are α emitters of similar energies, the $LD_{50/30}$ value for ^{238}Pu was found to be about twice that for ^{239}Pu on a μCi/kg basis. Differences in the tissue distribution of the two nuclides and a 270-fold difference in specific activity led to the suggestion that the difference in toxicity may be due to differences in physical state. A study is described with a view to directly examining the influence of physiocochemical state on the acute toxic properties of ^{238}Pu. Both monomeric and polymeric forms of ^{238}Pu were employed in rat tissue distribution studies. The two forms of ^{238}Pu were found to be distributed differently; data were obtained for the skeleton and liver. The polymer was more effective than the monomer in depressing weight gain; data were obtained for growth rate and for adrenal gland and spleen weights. The polymer produced death at all doses sooner than the monomer. It is concluded that acute toxicity of Pu is a function of its distribution which, in turn, is determined by the degree of polymerization, and that there is no intrinsic difference in toxicity of the two nuclides. (UK)

47928 RESULTS OF AN INTERNATIONAL COMPARATIVE INVESTIGATION ON TOTAL BODY COUNT IN THE EUROPEAN COMMUNITY. Smeets, J. (European Community Commission, Brussels); Schmier, H. Atoomenergie Haar Toepass., 11: 130-4(May 1969). (In Dutch).

The European Community Commission, in cooperation with the Federal Health Institute in Berlin, investigated the reliability of whole-body K and ^{137}Cs measurements in humans. Laboratories in Germany, Belgium, France, and Netherlands were covered. Corresponding studies were made in Italy. Methods and results of the 20 participating laboratories were evaluated at a conference in Berlin in December 1967. In general, reported results were in good agreement, though those of K showed better consistency than those of ^{137}Cs. Measurements of total K (based on ^{40}K) and of ^{137}Cs were made simultaneously in vivo with NaI scintillators with crystals in a fixed position. One measurement was made with a liquid scintillation counter. Tables and graphs are provided showing mean height, weight, and sex of tested persons; mean values for total K and ^{137}Cs for all laboratories; and ratios between the general mean and the individual mean values for K and ^{137}Cs for all laboratories. (F.J.W.)

47929 ACCUMULATION AND DISTRIBUTION OF THORIUM ISOTOPES IN THE ORGANISM OF ANIMALS AND MAN. Pavlovskaya, N. A. (Inst. of Labor Hygiene and Occupational Health, Moscow). Gig. Sanit., No. 4, 87-91(Apr. 1969). (In Russian).

Biological and radiotoxicological data indicate that thorium in the organism causes pathological changes in the spleen, liver, and lungs, which at a later date may develop into malignancies. The internal exposure dose for that amounts to 10^{-4} μCi/g of the animal. Distribution of the thorium in the body was found to depend on the concentration of the solution. If the original solution

contains 10^{-8} to 10^{-5} g/ml, the thorium is deposited in the bones; at higher concentrations, the amount deposited in the bones is decreased and the percentage in the liver is increased. Intratracheal introduction of noncomplex thorium compounds results in deposition of the element in the lungs. Histoautoradiographic studies revealed that the ThO_2 particles are unevenly distributed in the lungs. Intramuscular, intraperitoneal and subcutaneous introduction of the element also results in deposition in different organs, depending on the composition. Oral ingestion results only in deposition in the bones. Thus, the critical organ in which the thorium is deposited depends on the concentration of the solution, the chemical nature of the compounds used and the path used for introduction. (TTT)

47930 CONTRIBUTIONS TO THE UPTAKE OF ^{32}P IN VARIOUS TISSUES AS A FUNCTION OF THE SPECIES AND ENDOCRINE GLANDS IN ANIMALS SUBJECTED TO ACUTE PHYSICAL STRESS. Ardeleanu, Alexandra. Stud. Cercet. Fiziol., 14: No. 1, 35-41(1969). (In Rumanian).

In view of the importance of the endocrine glands for the response of the animal organism to stress, hypo- and hyperthyroid animals were studied to determine their reaction to stress situation, such as swimming for 60 minutes, exposure to temperatures of 38 to 39°C; the uptake of radioactive ^{32}P by the liver, adrenal glands, myocardium, pancreas, kidneys, and spleen was used as criterion. Mice, rats, and guinea pigs were used in the experiments. It was found that incorporation of the phosphorus was more intense in hyperthyroid animals. Species was also a factor: hyperthyroid mice incorporated ^{32}P more actively than the hypothyroid animals, in which the incorporation was greatly reduced. The corresponding differences were less marked in guinea pigs. In hyperthyroid rats the incorporation of ^{32}P was reduced, while in hypothyroid animals, it was increased. (TTT)

47931 THE INFLUENCE OF TEMPERATURE ON HISTOLOGICAL AND RADIOCHEMICAL MEASUREMENTS OF THYROID ACTIVITY IN THE EASTERN BROOK TROUT, SALVELINUS FONTINALIS MITCHELL. Drury, D. E.; Eales, J. G. (Univ. of New Brunswick, Fredericton). Can. J. Zool., 46: 1-9(Jan. 1968).

Histological and radiochemical techniques for assessing thyroid activity were compared on yearling brook trout acclimated at 5, 12, and 15°C. The mean thyroid follicle epithelial cell height was 7.4 μ (range 6.0–8.6 μ) at 5°C; 3.5 μ (range 2.9–3.9 μ) at 12°C, and 2.3 μ (range 1.9–2.9 μ) at 15°C. Assuming that a taller epithelial cell height indicates greater thyroid activity, then an inverse relationship between thyroid activity and acclimation temperature exists. Both the uptake of radioiodide by the thyroid (T/S) and the clearance of radioiodide from the serum were greater at higher temperatures. Serum $PB^{125}I$ production was negligible within 8 days after radioiodide injection and the conversion ratio could not be applied as an index of thyroid function. Assuming, however, that the thyroid radioiodide uptake is an index of thyroid activity, then there is a direct relationship between thyroid activity and acclimation temperature. In view of the marked discrepancy between these histological and radiochemical techniques, fractional rates of turnover of serum thyroxine were compared by determining the biological half-life ($t_{1/2}$) for serum $PB^{125}I$ after L-thyroxine-^{125}I intraperitoneal injection at different temperatures. The serum $PB^{125}I$ clearance curves were complex and tentative $t_{1/2}$ values of 18.0 days (5°C), 3.2 days (12°C), and 1.5 days (15°C) were obtained. These results indicate a more rapid serum PBI turnover at higher temperatures and support the radiochemical measurements. (auth) (CAN)

47932 PROPANOL AND THE UTILIZATION OF RADIOIODINE BY THE HUMAN THYROID GLAND. Hadden, D. R.; Bell, T. K.; McDevitt, D. G.; Shanks, R. G.; Montgomery, D. A. D.; Weaver, J. A. (Royal Victoria Hospital, Belfast). Acta Endocrinol., 61: 393-9(July 1969).

The effect of propanol on radioiodine metabolism by the thyroid gland was studied in 18 patients. Propanol has its principal action in reduction of the heart rate by blocking cardiac β-adrenergic receptor sites. Four different aspects of the passage of radioiodine through the thyroid were investigated: the trapping mechanism was studied by neck uptakes carried out after an intravenous dose of ^{132}I after treatment with propanol (40 mg 6-hourly by mouth); the progressive accumulation of radioiodine in the thyroid was measured at 15-min intervals during the first two hr after an oral dose of ^{132}I; the pattern of subsequent radioiodine concentration by the thyroid at four, 24, and 48 hr after an oral tracer dose of ^{131}I, and its conversion to protein-bound radioiodine (PBI), was studied; and serial blood levels of PBI were compared over a period of eight days before and after treatment with propanol. The doses of radioiodine used were 25 to 50 μCi ^{132}I, 20 μCi ^{131}I, and 20 μCi ^{125}I for each test. All parameters of radioiodine uptake by the thyroid (initial 5 to 20 min after intravenous administration, 2, 4, 24, and 48 hr after oral administration) were unaltered by propanol administration. In three of four patients studied an increase in isotopically labeled serum PBI was observed after 8-day propanol therapy. It is concluded that β-sympathetic blockade in the human does not affect radioiodine uptake by the thyroid gland. (BBB)

47933 THE INFLUENCE OF GENETIC AND ACQUIRED LIVER DEFECTS ON RADIOCOPPER TURNOVER IN WILSON'S DISEASE. Osborn, S. B. (King's Coll. Hospital, London); Walshe, J. M. Lancet, 2: 17-20(July 5, 1969).

Radiocopper metabolism was studied with both ^{64}Cu and ^{67}Cu in patients with untreated Wilson's disease in the presymptomatic (6), hepatic (6), and neurological (13) stages of the illness. The results were compared with similar studies made in patients with chronic liver disease. Control observations were also made on individuals heterozygous for Wilson's disease and normal individuals. The findings for plasma radioactivity, expressed as percentage of the dose of radiocopper injected per liter of plasma at 2 and 24 hr, are shown. The ratio, radioactivity at 24 hr/radioactivity at 2 hr, is also shown, since this is an index of incorporation of copper into ceruloplasmin. These results showed that the plasma radioactivity in patients with neurological Wilson's disease is significantly raised at 2 hr compared with the patients with hepatic disease, confirming the slow rate of removal of radiocopper in this condition. Estimation of the ratio of radioactivity in the plasma at 24 hr compared with that at 2 hr separated the patients with Wilson's disease from patients with liver disease and from the control groups. Uptake of radiocopper by the liver was only rarely severely depressed in patients with chronic liver damage but was always very severely depressed in patients with untreated neurological Wilson's disease. It was not possible to show any correlation between the degree of liver damage measured either histologically or biochemically and the reduced uptake of radiocopper by the liver in the latter group of patients. (BBB)

47934 INVESTIGATION ON THE FACTORS INFLUENCING THE PERMEATION OF COLLOID GOLD (^{198}Au) TO THE LYMPH-NODES IN CASES OF INTRA-TISSULAR INJECTIONS OF THE PREPARATION. Shcheglov, Sergiej Pol. Przegl. Radiol. Med. Nukl., 33: 357-63(May-June 1969). (In Polish).

Experiments designed to estimate the influence of the animal's age and the stage of neoplastic development upon the permeation of colloid ^{198}Au preparation into the lymph nodes after intratissular injection are described. Marked differences were stated in the degree of radiocolloid permeation into the lymph-nodes in relation to the animals' age. In animals inoculated with neoplasm (Sarcoma 45 and M-I) the amount of ^{198}Au was smaller in the lymph nodes in comparison with healthy subjects. The results point to the dependence of permeation on the state of the connective tissue. Changes occurring in the connective tissue are, in turn, related with the animal's age or the neoplastic outgrowth processes. The observed phenomenon may be treated as one of the causes of poor therapeutic results of colloidal gold therapy in certain cases in human clinic. (auth)

47935 ACUTE TOXICITY OF REACTOR POLYPHENYLS ON THE LUNG. Adamson, Ian Y. R.; Bowden, Drummond H.; Wyatt, John P. (Univ. of Manitoba, Winnipeg). Arch. Environ. Health, 14: 499-504(Oct. 1969).

Mice were exposed to an aerosol of a polyphenyl reactor coolant for several hours daily up to eight days. The oil concentration was comparable to that measured in the atmosphere at the reactor site. No evidence of lung injury was detected by light microscopy. At the ultrastructural level, many type 2 alveolar epithelial cells showed central vacuolation of mitochondria. These cells exhibited the normal turnover time of around 35 days. Following the cessation of aerosol exposure, the succeeding generation of epithelial cells showed no abnormality. (auth)

47936 UPTAKE AND TRANSLOCATION OF ^{134}Cs, ^{59}Fe, ^{85}Sr, AND ^{185}W BY BANANA PLANTS AND A COCONUT PLANT FOLLOWING FOLIAR APPLICATION. Thomasson, W. Neill; Bolch, W. Emmett; Gamble, J. F. (Univ. of Florida, Gainesville). Bioscience, 19: 613-5(July 1969).

Soluble forms of ^{185}W, ^{85}Sr, ^{134}Cs, and ^{59}Fe were applied to the fronds of the coconut palm and the leaves of the banana tree. Seventeen days after application of radioisotopes tissue samples were processed to a homogeneous state using a food blender. Gamma ray spectrometry was used for analysis of leaves, fruits, stems, and soil extracts. Computer analysis of the data showed a high selectivity for ^{134}Cs over the other three radionuclides. There was greater translocation in the banana plant than in the coconut. Cesium-134 exhibited measurable movement to adjacent plants 15 to 20 ft away. There was slight but measurable concentration of ^{185}W in the banana peels of the fruit of the treated tree, as well as

the peels of fruit from adjacent trees; however, no ^{185}W was found in the fruit. New, young leaves above the treated ones contained all of the radionuclides used, but ^{134}Cs was by far the most dominant. There was much less translocation of ^{134}Cs to the fruit of the coconut tree. Small amounts of ^{185}W, ^{85}Sr, and ^{59}Fe were translocated to untreated fronds above and on the opposite side of the palm from the treated fronds. (H.L.W.)

47937 CALCIUM AND STRONTIUM METABOLISM IN JAPANESE AND BOBWHITE QUAIL. Mraz, Frank R. (Univ. of Tennessee, Oak Ridge). Contract AT(40-1)-GEN-242. Poultry Sci., 48: 737-9(Mar. 1969).

The metabolism of ^{45}Ca and ^{89}Sr was compared in Japanese quail (Coturnix coturnix japonica) and Bobwhite quail (Colinus virginianus). A 25-μCi dose of either isotope was administered orally to the quail before their first feeding. At periodic intervals, birds were sacrificed and a tibia removed from each for radionuclide determinations. The biological half-life of ^{89}Sr in the tibia of Japanese and Bobwhite quail between 1 and 56 days of age was about 20 days, starting with about 2% of the administered oral dose of ^{89}Sr 1 day after dosing. This was comparable to that in White Leghorn chicks except that 4% of the ^{89}Sr was present 1 day after dosing. The biological half-life of ^{45}Ca in quail was about 40 days with an initial uptake by the tibia of 4% of the ^{45}Ca 1 day after dosing. This percentage was twice that of ^{89}Sr. The day-old quail chicks deposited more ^{45}Ca and ^{89}Sr in the tibia than did older birds. Deposition of the radionuclides in the tibia of Bobwhites was higher than that in Japanese quail after 3 weeks of age and was not influenced by sex over the 16-week period. The influence of egg production in the Japanese quail was reflected in the increased ^{45}Ca and ^{89}Sr deposition in tibia of laying females over that found in males at 8 weeks of age and continued for those observed at 10 and 12 weeks of age. More of the radionuclides were deposited in the tibia of Bobwhite than male Japanese quail because they were still in the state of skeletal growth. Thus, the biological half-lives of the isotopes in both species are similar prior to maturity but the effect of impending maturity in the Japanese quail decreases Ca and Sr deposition in the tibia after 4 weeks of age until maturity when the female Japanese quail again increases deposition. (BBB)

47938 THE INFLUENCE OF FERTILIZERS ON THE DISTRIBUTION OF STABLE AND RADIOACTIVE (^{54}Mn) MANGANESE IN ALPINE FIELD PLANTS. Ananyan, V. L.; Mnatsakanyan, B. G.; Araratyan, L. A. (Inst. of Agrochemical Problems, Erevan). Dokl. Akad. Nauk Arm. SSR, 48: 115-19(1969). (In Russian).

The influence of fertilizers (P, N, K) on the uptake of stable and radioactive manganese by hay in the Agaratz fields in the Alpines at 3250 m elevation was studied. The mountain field soil was brown with a high content of organic substances and normal contents of nitrogen and phosphorus. The soil had an acid reaction and the pH of the water was 4.4. Manganese-54 was present in the upper layer to a depth of 5 cm. Data obtained showed that the increase of harvest caused by the fertilizer reduced the amount of manganese taken out of the soil. It was suggested that the fertilizer should be supplemented by manganese in order to maintain a good harvest. (R.V.J.)

47939 RADIOIODINE IN THE MILK OF COWS AND GOATS AFTER ORAL ADMINISTRATION OF RADIOIODATE AND RADIOIODIDE. Lengemann, F. W. (Cornell Univ., Ithaca, N. Y.). Contract AT(30-1)-2147. Health Phys., 17: 565-9(Oct. 1969).

Two lactating cows and goats were each given orally a single dose of ^{131}I as sodium iodide and ^{125}I as sodium iodate and the milk, plasma, feces and urine collected over a 7 day period. Three cows and two goats were also given twice daily doses of the labeled iodide-iodate for a period of about 14 days with complete collections made only during the last 4 days. The data show that the metabolism of iodate and iodide under these conditions was markedly similar. The relatively minor differences that became apparent suggest that iodate is not absorbed from the digestive tract as readily as iodide and that iodate may differ in its rate of transfer into milk. (auth) (UK)

47940 THE DISTRIBUTION OF THORIUM IN RATS' BONES FOLLOWING INTRODUCTION BY VARIOUS ROUTES AND CHEMICAL FORMS. Pavlovskaya, N. A.; Makeeva, L. G.; Orlyanskaya, R. L. Gig. Sanit., No. 8, 27-31(Aug. 1969). (In Russian).

Experimental findings proved the distribution of thorium in the body to be practically independent of the route of its introduction. The chemical nature of the compound introduced had a significant effect on the distribution of thorium in various bone fractions. When noncomplex compounds of thorium were administered its content in the mineral fraction of the bone tissue fluctuated from 32 to 52%. However, in the introduction of EDTA the thorium content of the mineral fraction fell to 11 to 18% and that of the organic fraction increased accordingly. Of the investigated fractions of the bone tissue, albumoides and mucopolysaccharides were most closely related to thorium. A relative specific concentration of thorium therein was 20 times higher than in the collagen and mineral fraction of the bone tissue. (auth)

47941 THE TOXICITY OF TRITIUM OXIDE INHALATION IN RATS. Zhuravlev, V. F.; Bugryshev, P. F.; Smirnova, T. N.; Kuzmina, T. D.; Kalistratova, V. S.; Kryuk, V. F.; Shalnova, G. A.; Markelova, M. N. Gig. Sanit., No. 8, 32-6(Aug. 1969). (In Russian).

Data on the toxicity and distribution of tritium oxide in rats after its inhalation at a concentration of 2.2 and 3.6 MCi/l are presented. The animals presented pronounced changes of blood: a fall in the number of leucocytes, thrombocytes, and reticulocytes. Considerable shifts were noted in the quantity of blood β-lipoproteins. The blood cholinesterase activity fell significantly. When introduced by the respiratory routes, tritium oxide distributed itself uniformly in all the organs and tissues of the body. The removal of tritium from the body proceeded in two stages: $T_1 - 2.5$ days and $T_2 - 64$ days. Its maximum permissible concentration in the air of working premises was suggested to be set at a level of $5 \cdot 10^{-9}$ Ci/l. (auth)

47942 EFFECTS OF SOIL FACTORS ON THE UPTAKE OF RADIOSTRONTIUM BY PLANTS. PART I. Lakanen, Esko; Paasikallio, Arja (Agricultural Research Centre, Tikkurila, Finland). Ann. Agr. Fenn., 7: Ser. Agrogeol., Chim. Phys., No. 35, 89-94(1968).

The effect of soil type and pH on the uptake of ^{89}Sr by timothy was studied in a pot experiment. The increase of soil pH reduced the uptake of ^{89}Sr. The effect of soil type was more pronounced and the $^{89}Sr/Ca$ ratio of the plant clearly decreased in the order: finesand, heavy clay, Spagnum peat, and Carex peat. (auth)

47943 CHRONIC BERYLLIUM DISEASE: LONG-TERM FOLLOW-UP OF SIXTY CASES AND SELECTIVE REVIEW OF THE LITERATURE. Stoeckle, John D.; Hardy, Harriet L.; Weber, Alfred L. (Massachusetts General Hospital, Boston). Amer. J. Med., 46: 545-61(Apr. 1969).

Sixty cases of chronic Be disease are reviewed including four who were exposed in nuclear energy applications of Be. Another 20 cases are known in which Be exposure occurred in nuclear industry. Altogether 300 cases are known, and literature concerning all of them are reviewed. Tissues were examined from either lung biopsies, postmortem examinations, or both in 20 (33%) of the 60 patients. Each had a granulomatous pneumonitis. In pathologic studies of the lung in these and other cases it was possible to distinguish two general histologic patterns. The most frequent pattern (80%) was a widely disseminated cellular infiltration with little tendency to formation of granulomas; in the less common pattern (20%) cellular infiltration was generally focal and mild and there were prominent well formed granulomas, a histologic appearance indistinguishable from that of sarcoidosis. Patients with the latter findings had a longer and more benign course. Beryllium analyses on the lung specimens in this series ranged from 0.03 to 21.0 μg/100 g tissue. Diagnosis is based on two sets of criteria, one epidemiologic and the other clinical. The epidemiologic criterion is a significant Be exposure. The clinical criteria include diffuse densities on roentgenograms, with or without symptoms; patterns of respiratory insufficiency initially characterized by a reduction in lung volumes and/or "diffusion capacity" with later obstructive defect depending on the degree of fibrosis; interstitial pneumonitis, usually granulomatous, determined by examination of lung biopsy or autopsy specimens; systemic toxicity demonstrated by functional or pathologic abnormalities in tissues other than lungs; and Be in tissues. A diagnosis consists of significant exposure and the presence of at least the first two clinical criteria. (BBB)

47944 DISTRIBUTION OF ORGANIC MERCURY COMPOUNDS AND ACTIVITY OF ALCOHOL DEHYDROGENASE. Niwaguchi, Tetsukichi; Otsuka, Nobuko (National Research Inst. of Police Science, Tokyo). Kagaku Keisatsu Kenkyusho Hokoku, 21: 265-8(Dec. 1968). (In Japanese).

Phenylmercuric acetate (PMA) and ethylmercuric chloride (EMC) labeled with ^{203}Hg were orally administered to rats and the accumulation of ^{203}Hg in the tissues with the lapsed time was traced. At the same time, the intracellular localizations of ^{203}Hg in the liver and the kidney were studied. The retained radioactivity in the tissues at 24 hours after administration of EMC was larger than that of PMA except in the kidney, the intestines and the stomach. Mercury-203 distributed in the tissues by administration of PMA diminished markedly in next 48 hours, however,

Hg in case of EMC decreased gradually. In the kidney and the liver, the largest amount of ^{203}Hg was distributed in the supernatant following centrifugation fractionation. The activity of alcohol dehydrogenase in the liver supernatant was reduced with the amount of the distributed Hg. (auth)

47945 DETERMINATION OF ^{75}Se-METHIONINE HALF-LIFE IN THE BLOOD AND THE STUDY OF ITS UPTAKE IN PLASMATIC PROTEINS. Szantay, I.; Cotul, S. Rev. Roum. Med. Interne, 5: No. 3, 173-8(1968). (In French).

A study on the biological half-life (T/2) of methionine in patients suffering from evolutive chronic hepatitis, as against controls revealed that ^{75}Se-methionine may be substituted in this test by ^{35}S-methionine. This substitution allows for the reduction of the tracer dose from 100 and 160 μCi to 10 μCi. Simultaneously, a new method was developed for the estimation of ^{75}Se-methionine uptake-rate in plasma proteins. Determination of this parameter could be a velocity test of plasma protein synthesis in hepatopathies. (Rom. Sci. Abstr.)

47946 CONTRIBUTION TO THE PROBLEM OF PRIMARY NECROTIZING CARDIOPATHIES AND IONIC CHANGES IN THE MYOCARDIUM AND BLOOD SERUM DURING THEIR GENESIS. Vasku, J.; Urbanek, E.; Praslicka, M. Cas. Lek. Cesk., 107: 691-5(May 31, 1968). (In Czech).

A combined chemical (F-CoI + Na_2HPO_4) and physical (continuous ^{60}Co γ irradiation) cardiotoxic attack was induced in rats. Necroses developed in the myocardium associated with raised intracellular Ca and Na levels and a less marked change of the K level. These changes were prevented by administration of K–Mg aspartate. The intracellular rise of the Ca level was a very important trigger mechanism. The cumulation of ^{42}K and ^{24}Na did not correspond to the change in the levels of these inactive ions on the myocardial cells. A twofold metabolic pathway of these two ions may exist. (auth)

47947 ORAL INGESTION OF URANIUM BY MAN. Hursh, J. B.; Newman, W. R.; Toribara, T.; Wilson, H.; Waterhouse, C. (Univ. of Rochester, N. Y.). Health Phys., 17: 619-21(Oct. 1969).

ICRP Publication 6 (1963) adopts an absorption factor of 1% for soluble uranium and an $(MCP)_W$ value of 2×10^{-5} μCi per cc, based on the kidney as critical organ. In an attempt to form a somewhat broader base for choice of an absorption factor, experiments were made on four suitable human volunteers who ingested a small quantity of soluble uranium. Calculation showed that 10.8 mg U (as UNH) by mouth would be a suitable dose in terms of radiation and toxicological safety, and in terms of sensitivity of the available analytical techniques. The UNH was administered in Coca-Cola. Details of urine and feces collection and analysis are given; uranium levels were measured by an up-dated version of Neuman's fluorimetric procedure, embodying isolation of the uranium by protein precipitation. Results are shown graphically; none of the curves reached a plateau and the data do not, therefore, permit precise estimates of the total uranium absorption. It can only be stated that the amount absorbed varied from 0.3 to 3% of the ingested dose for the four subjects. It was considered reasonable to multiply these values by about 1.5 to take care of probable skeletal uptake. It is considered that the experiments lend some support for the new ICRP value of 1%, although the variation between subjects is disturbing. An interesting finding was the apparent prolongation in the pattern of urinary excretion; this is discussed. (UK)

47948 EFFECT OF 1,3-DIAMINOPROPANOL-2-TETRAACETIC ACID ON THE EXCRETION OF SOME RADIOISOTOPES OF METALS. Klyachina, K. N.; Podgornata, I. V.; Ivakin, A. A. (Inst. of Labor Hygiene and Occupational Diseases, Sverdlovsk, USSR. Inst. of Chemistry, Sverdlovsk, USSR). Gig. Tr. Prof. Zabol., No. 12, 30-2(1968). (In Russian).

The rate of elimination of radioactive isotopes of various metals was used as an indicator in the study of the formation of water-soluble metallic complexes of 1,3-diaminopropanol-2-tetraacetic acid (DPTA). One to two minutes after subcutaneous injection of rats with the isotopes, the animals were injected intraperitoneally with an aqueous solution of DPTA neutralized with a 5% $NaHCO_3$ solution to a pH of 7.3. DPTA markedly accelerated the excretion of zinc and cadmium in urine, cobalt, manganese, and nickel to a lesser extent, and copper even less, but it had no effect on the rate of excretion of chromium, mercury, and tellurium. The increased excretion of zinc and cadmium, as compared with the control, persisted for 2 days. Most of these metals were excreted in the feces on the second day, as in the control. DPTA increased the excretion of cobalt in urine 700 to 1,000%. The elimination of manganese and nickel in urine in the treated rats occurred only on the first day, and it was 2.3 to 2.5 times higher than in the control. The instability constants for complexes of DPTA with manganese, zinc, cadmium, cobalt, copper, nickel, and mercury were much higher than those for the DPTA-copper complex. (JPRS)

47949 UPTAKE OF POLYMERIZABLE RADIOELEMENTS IN LIVER AS A FUNCTION OF THEIR PHYSICO-CHEMICAL STATE. Slouka, V. (University Hospital, Hradec Kralove, Czech.). Atomkernenergie, 14: 245-8(July-Aug. 1969).

The chlorides of ^{140}La, ^{141}Ce, and ^{175}Yb were injected to rats intravenously or into the portal circulation either carrier-free or with 10 mmol of isotopic carrier, at pH 4 or at pH 8. The rate of disappearance from blood plasma and the primary distribution is a function of the physico-chemical state of the injected solution. The uptake in the spleen after a portal injection is a good measure for the phagocytic efficiency of the liver. The results show the great importance of the physico-chemical state of the solution of La on its metabolic behavior. This must be taken into account in formulation of a kinetic model. (auth)

47950 DISTRIBUTION OF RADIATION DOSES IN ORGANS OF MAMMALS FOLLOWING INHALATION OF ^{220}Th. Plattner, Helmut (Univ., Innsbruck. Oesterreichische Akademie der Wissenschaften, Vienna). Oesterr. Akad. Wiss., Math.-Naturwiss. Kl. Sitzungsber., Abt. II, 178: 381-437(1968). (In German).

By inhalation, Thoron was administered to guinea pigs, mice, and rabbits. Subsequently, its decay products were determined in various organs. The concentration of ^{212}Pb was highest in lungs, blood cells, kidneys, and liver; medium concentrations were found in adrenals, pancreas, adipose tissue, bone, spleen, brain, and lymph nodes; low concentrations occurred in the intestine, gonads, muscle, and blood plasma. In mice, whole-body concentration of ^{212}Pb was four to five times higher than in guinea pigs; this difference can be explained by the higher metabolic rate of mice. ^{212}Bi was enriched selectively in blood plasma, urine, bile, and kidneys. The deposition of ^{212}Pb and ^{212}Bi occurred to the organ affinity of lead and bismuth, respectively. (H.B.G.)

Radiation Effects

Refer also to abstracts 47457–47462, 48007, 48200, 48201, 48265, 48267, 48284, 48288, 48301, and 48303.

47951 (AEC-tr-6871/6) UKRAINIAN JOURNAL OF BIOCHEMISTRY. Translation of Ukr. Biokhim. Zh., 39: No. 6, 571-680(1967). 130p. (TT-68-50323/6; IPST-Cat.-5122). Dep. CFSTI.

A separate abstract was prepared for one paper in this journal. Seventeen additional papers are included on chemical properties of proteins of brain and muscle, effects of hormones on brain metabolism, and other biochemical studies. Other papers within the scope of NSA were abstracted from the original language. (H.L.W.)

For an abstract of the individual paper see: 47952.

47952 (AEC-tr-6871/6, pp 95-101) EFFECT OF IONIZING RADIATION ON THE BIOSYNTHESIS OF INDIVIDUAL FRACTIONS OF SOLUBLE KIDNEY PROTEINS. Sukhomlynov, B. F.; Dats'kiv, M. Z. Translated from Ukr. Biokhim. Zh., 39: 654-8(1967).

It was shown previously that x rays lead to intensive impairment in the protein metabolism of animals. In this study the effect of ionizing radiation on the biosynthesis of individual fractions of the soluble kidney proteins in various stages of radiation sickness was studied by agar gel electrophoresis and subsequent autoradiography of the electrophoretogram. (auth)

47953 (UCLA-12-724, pp 23-33) BIOCHEMISTRY. (California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology).

Interim reports are presented for seven studies conducted by the Biochemistry group. The seven studies include: the biosynthesis of unsaturated fatty acids by Bacilli; temperature dependent biosynthesis of polyunsaturated fatty acids; studies on blood brain barrier; role of creatine phosphate in ATP resynthesis; techniques for isolating and identifying myosin and heart muscle ribonucleic acids; study of techniques for analyzing myosin and growth of heart cells; gamma radiolysis of saturated fatty acid, identification and characterization of dehydrodimeric products; and the wax esters of a marine copepod as affected by diet. A list of publications for the current report period is also given. (E.R.B.)

47954 (UCLA-12-724, pp 71-87) RADIOBIOLOGY. (California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology).

Interim and final reports are presented for 18 studies conducted by the Radiobiology group. The 18 studies include: Pulse radiolysis studies on 5-bromouracil and 5-bromouracil-substituted DNA;

An EPR study of irradiated frozen aqueous sugar solutions; Pulse radiolysis of cysteine, cystine, and DNA; X-radioinduced binding of N-ethyl maleimide to DNA in aqueous solutions; A mechanism for N-ethyl maleimide radiosensitization; Radiosensitization by N-ethyl maleimide—a model chemical system; Effect of chloride ion on the radiation induced destruction of nucleosides and nucleotides; Effect of chloride ions on the γ-radioinduced destruction of nucleic acid bases in aqueous solution; Micro estimation of RNA by the cupric ion catalyzed orcinol reaction; Organ-specific estrogen-induced RNA synthesis resolved by DNA-RNA hybridization in the domestic fowl; Isolation and preliminary chemical analysis of coated vesicles from chicken oocytes; Effects of ionizing radiation on the biochemical differentiation of the rat brain; Effects of ionizing radiation on hormonal induction of enzymes in the developing and adult rat brain and in an established line of glial cells; Differentiation of cloned clial cells in culture; Fine structure in the near uv circular dichroism and absorption spectra of tryptophan derivatives and chymotrypsinogen A at 77°K; Dose response—Erythropoietin units versus percent uptake of ^{59}Fe; Evaluation of hypoxia-induced polycythemic mice; and Erythropoiesis in testosterone treated rats. (E.R.B.)

47955 (UH-235-P-5-4, pp 115-20) ULTRASTRUCTURAL STUDIES ON IRRADIATED AND UNIRRADIATED PAPAYA FRUIT TISSUE. Buddenhagen, I. W.; Takata, G. S. (Hawaii Univ., Honolulu. Coll. of Tropical Agriculture).

Irradiated mature-green papaya fruit undergo ripening more slowly than non-irradiated papaya, a change which encompasses many altered physiological activities. There is an increase in peroxidase activity in the irradiated fruit, and tissue firmness is retained longer. These changes reflect alteration in enzymes which are sequentially activated or deactivated in the normal ripening process. Electron microscopical studies were initiated in an attempt to correlate biochemical changes with morphology in papaya ultrastructure after irradiation. This also involved an examination of normal mature-green papaya undergoing ripening and senescence, in order to distinguish these effects from those which could be attributed to the irradiation treatment. (auth)

47956 (UH-235-P-5-4, pp 169-75) INFLUENCE OF pH AND CONCENTRATION ON THE TBA VALUES OF GAMMA-IRRADIATED GLUOSE AND SUCROSE SOLUTIONS. Upadhya, Mahesh D.; Brewbaker, James L. (Hawaii Univ., Honolulu. Coll. of Tropical Agriculture).

Experiments were designed to estimate the influence of pH and concentration on the amount of induced peroxides in glucose and sucrose solutions following gamma-irradiation. A technique for peroxide estimation on the basis of the thiobarbituric acid (TBA) reaction in sugar solutions has been standardized. The results show higher TBA values in sucrose than in glucose solutions at a given concentration; TBA values increased with the increase in pH of the solutions at the time of irradiation; and TBA values do not show increase correlated with the dose. (auth)

47957 (UH-235-P-5-4, pp 176-82) EFFECT OF pH ON THE PEROXIDE SCAVENGING ACTION OF CYSTEINE IN SUCROSE AND GLUCOSE SOLUTIONS. Upadhya, Mahesh D. (Hawaii Univ., Honolulu. Coll. of Tropical Agriculture).

Experiments were conducted to evaluate the relative effectiveness of cysteine as scavenger of irradiation-induced peroxides in glucose and sucrose solutions at acidic, near neutral, and alkaline buffers. The results indicate that cysteine is an effective SH-containing scavenger of irradiation-induced peroxides in sugar solutions. The scavenging activity is most effective near neutral pH (6.5), much less at the acidic pH and ineffective at the alkaline pH. The results are discussed in the light of earlier reports, with a view of evolving a possible relationship between SH-content peroxide contents of irradiated fruits for the estimation of irradiation effects. (auth)

47958 RADIATION-INDUCED CELLULAR CHANGES IN TRAUMATIC SPINAL CORD INJURY. Ticer, James W.; Tietz, William J. (Colorado State Univ., Fort Collins). Acta Neuropathol., 13: 122-30(June 9, 1969).

The radiosensititivity of DNA synthetic and proliferative abilities of the cells involved in spinal cord scar formation was compared. Left dorsal cordotomy at the 11th thoracic vertebra was performed in mature female rats. Local exposures of 1000 R of 280-KVp x rays were made within 10 min, 12, 24, 36, or 48 hr after injury. Tritiated thymidine (1 μCi/g body wt) was injected one hr before death and necropsy examination was performed five, 18, or 30 days after surgery. Hematoxylin-stained sagittal sections (5 μ) of the spinal cord were prepared for radioautographic examination. The magnitude and duration of changes in cell numbers and numbers of cells incorporating tritiated thymidine were determined for scar parenchymal cells (neuroglia and fibroblasts), macrophage, endothelia, and mitotic cells. Irradiation modified the cellular composition of the developing scar tissue, seen as a delay of proliferation in scar parenchymal and endothelial cell populations. Fewer cells incorporated tritiated thymidine in 5-day-old irradiated lesions. The magnitude and duration of these delays varied with the cell type and the time of irradiation after injury. Evidently scar parenchymal and endothelial cells proliferated in situ from progenitor cell populations that were in the lesions at the time of irradiation. Macrophage cell numbers and numbers of these cells incorporating tritiated thymidine were not decreased after irradiation, indicating that most macrophages did not originate from a local progenitor cell population. (BBB)

47959 PROTECTIVE ACTION OF O-(β-HYDROXYETHYL)-RUTOSIDE AGAINST THE RADIOINDUCED INHIBITION OF ENERGY METABOLISM. Fritz-Niggli, Hedi (Univ., Zurich). Praxis (Bern), 57: 180-3(1968). (In German).

The effect of a flavinoid derivative on oxidative phosphorylation in isolated mitochondria x irradiated with a 10,000 R dose was studied. The experiments described show that tris(hydroxyethyl)-rutin (HR) attenuates, and sometimes counteracts completely, the detrimental effect of irradiation and of iodoacetamide upon oxidative phosphorylation in isolated mitochondria of rat liver. These findings suggest possibilities for using HR as a selective agent to protect healthy tissues against the effect of therapeutic radiation, since in most cases normal cells contain more mitochondria than tumor cells. The question of how HR exercises its protective action is unanswered, but flavonoids may be implicated in the chain of respiration enzyme reactions. It is also likely that HR attenuates changes in permeability caused by irradiation and the enzyme activity of mitochondria may be influenced by variations in permeability. A comparative study now in progress on the individual components of HR may further elucidate this question. (BBB)

47960 VIRAL RNA SYNTHESIS IN CHICKEN CELLS INFECTED WITH ULTRAVIOLET IRRADIATED NEWCASTLE DISEASE VIRUS. Huppest, J.; Hillova, J.; Gresland, L. (CNRS, Villejuif, France). Nature (London), 223: 1015-17(Sept. 6, 1969).

Studies are reported in which it was shown that chick embryo cells infected with uv-irradiated-NDV synthesize viral RNA, although they do not produce infectious virus. The viral origin of the RNA was demonstrated by annealing experiments using RNA from purified NDV virus. (auth) (UK)

47961 ERROR FREQUENCY DURING IN VITRO TRANSCRIPTION OF POLY U IS INCREASED WITH γ-IRRADIATED RNA POLYMERASE. Goddard, J. P.; Weiss, J. J.; Wheeler, C. M. (Univ. of Newcastle upon Tyne, Eng.). Nature (London), 222: 670-1(May 17, 1969).

It was thought that irradiation might possibly damage the sites on an RNA polymerase molecule involved in base selection, although not necessarily causing loss of catalytic activity. Studies undertaken to investigate this possibility are described. RNA polymerase samples, dissolved in glycerol, were uv irradiated for up to 15 min. at 77°K and at $\sim 5 \times 10^{16}$ quanta/sec. Ammonium sulphate precipitated enzyme, dissolved in KCl, was also ^{60}Co γ-irradiated at 77°K to 0.1–0.8 MR at 0.1 MR/hr. Synthesis, incubation, washing, and nearest neighbor analyses were performed. In order to check the amount of non-complementary base incorporated, the wrong base NTP (nucleoside triphosphate) was labeled with ^{14}C and the normal base with ^{3}H, and differential counting was made. Irradiation of RNA polymerase with uv light led to no changes in the relative amounts of NpU and NpA in the Poly A and Poly U primed synthesis, and no change was found in the percentage of NpU when Poly A was transcribed by γ-irradiated RNA polymerase. The product synthesized with γ-irradiated RNA polymerase directed by Poly U, however, contained GMP, the amount of GpA in the product increasing approximately linearly with increasing dose, accompanied by a corresponding decrease in the amount of ApA. No change was found in the amounts of UpA or CpA. The increase in GMP represented an increase in error frequency. Total GMP incorporated decreased with increasing dose, but the decrease was less than that for total AMP incorporated. The nature of the radiolytic species causing malfunction of RNA polymerase has not been clearly established, and the site of attack is also a matter for speculation. Either disruption of the tertiary structure of the enzyme or damage to the amino-acids comprising the active site involved in base selection could lead to malfunction. (UK)

47962 EFFECT OF ACUTE RADIATION DAMAGE ON BIOSYNTHESIS OF PROTEIN IN ISOLATED MITOCHONDRIA OF ALBINO RAT LIVER. Galkin, A. P.; Germatenko, M. V.; Todorov, I. M. (Research Inst. of Medical Radiology, Kharkov). Ukr. Biokhim. Zh., 41: 296-300(1969). (In Ukrainian).

The effect of acute radiation damage (dose of 800 R) on biosynthesis of protein in isolated mitochondria and in crossed systems

(mitochondria supernatant fraction) of the liver was investigated in normal and irradiated rats. It is established that radiation provokes disturbances of the mitochondrial protein-synthesizing system proper that are manifested in a decrease of the specific radioactivity of some protein components of the isolated mitochondria (structural, contractile components and fraction of other cytochromes), incubated with leucine-^{14}C 12 hrs after irradiation. The disturbances in the supernatant fraction caused by radiation affect in addition the inhibition of mitochondrial protein biosynthesis that is expressed in still greater decrease of the specific radioactivity of the mentioned protein components. The obtained data provide evidence not only for the mentioned disturbances, but confirm autonomy of biosynthesis of some mitochondrial proteins. (auth)

47963 EFFECT OF PROTON IRRADIATION ON SERUM AND TISSUE LDH ISOENZYMES. Hawrylewicz, E. J.; Blair, W. H. (IIT Research Inst., Chicago). pp 927-37 of Progress in Radiology. Vol. I. Turano, L.; Ratti, A.; Biagini, C. (eds.). New York, Excerpta Medica Foundation, 1967.

From 11th International Congress of Radiology, Rome. See CONF-650907-(Vol.1).

Exposure of monkeys to ionizing radiation causes marked alterations in the serum and the tissue LDH enzyme activity. The increase of serum activity is a reflection of an immediate increase in the anaerobic LDH isoenzymes, and subsequently an inversion and cross-over point are observed. At this point the aerobic LDH isoenzyme activity predominates. The extent of the increase, the rate of the increase, and the extent of alteration of the isoenzyme ratios are functions of dose, energy level, and type of radiation. Gamma radiation produces the most rapid and severest response. Within the limits of the data, the radiation source, the energy level, and the dose can be identified by the serum and tissue LDH and LDH isoenzyme activities. (auth)

47964 THE EFFECT OF NEONATAL X IRRADIATION ON THE ACCUMULATION AND DEGRADATION OF ^{131}I-l-TRIIODOTHYRONINE IN THE MATURING RAT CENTRAL NERVOUS SYSTEM. Cohan, Stanley L.; Ford, Donald H.; Rhines, Ralph K.; Thompson, Donald (Downstate Medical Center, Brooklyn). Acta Neurol. Scand., 45: 129-50 (1969).

The effect of x irradiation on the central nervous system (CNS) was studied on the basis of ^{131}I-triiodothyronine (^{131}I-T$_3$) accumulation and degradation. Male Wistar rats received 100 R to the head within 12 hr of birth and were sacrificed following intravenous injection of ^{131}I-T$_3$, at 1, 2, 3, or 4 weeks of age. Irradiation of the brain significantly depressed accumulation of ^{131}I-T$_3$ by the CNS when compared with controls, despite higher circulating levels of ^{131}I-T$_3$ in the blood plasma of irradiated rats. Furthermore, irradiation was associated with a reduction in the amount of degradation products of ^{131}I-T$_3$ (^{131}I-monoiodotyrosine and ^{131}I-diiodotyrosine, MIT and DIT) which were present in irradiated rat brains as compared with controls at any of the ages studied. There was however, no consistent pattern in the changes in the levels of free ^{131}I in irradiated and control brains suggesting any predictable effect on a dehalogenating enzyme. Evidently neonatal 100-R x irradiation depresses the activity of an enzyme splitting the thyronine molecule at the ether bond in the brain while having no effect on dehalogenase activity. The decreasing levels of labeled triiodothyronine seen in the plasma of normal young and adult rats at various time intervals after intravenous injection of ^{131}I-T$_3$ were not clearly demonstrable in irradiated rats until the fourth week after irradiation. The concommitant increase in free iodide in the plasma with increasing time after injection was also not observed until the fourth week. Since these observations on plasma levels of ^{131}I-T$_3$ and free iodide as well as in ^{131}I-MIT and ^{131}I-DIT reflect the overall bodily metabolism of thyroid hormone, these changes imply that 100-R irradiation of the head of neonatal rats may influence the metabolism of thyroid hormone in the rest of the body, possibly by an effect on the pituitary. (BBB)

47965 A STUDY OF RADIATION INJURY OF THE ERYTHROCYTE MEMBRANE. Miyachi, Machiko (Osaka Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 28: 1587-1601(Mar. 1969). (In Japanese).

Investigations were made on the initial damage to the cell membrane following a low dose of irradiation. Rat and human erythrocytes were irradiated with $^{3}H_2O$ and ^{60}Co γ rays. An increase in the capacitance and a decrease in the conductivity of the erythrocyte suspension were observed from the beginning up to 600 rads. Irradiation with more than 800 to 1000 rads resulted in a decrease of capacitance and in an increase of conductivity of the cell suspension. The capacitance and conductivity, when measured after irradiation maintained less changes than those measured during irradiation. This suggests that some of the changes observed during irradiation are apparently reversible. The above findings may be interpreteu as the changes of ion permeability of the cell membrane. Regarding membrane permeability for $^{3}H_2O$, no significant difference was observed between 600 rad irradiated samples and non-irradiated ones, in 0.9 and 1.5% NaCl solutions. In 0.5% NaCl solution however an increase of permeability was observed in 600 rad irradiated samples. In 1000 rad irradiated samples, even in 0.9 and 1.5% NaCl solutions, permeability was increased and the changes were enhanced in proportion to the doses given. In 0.5% NaCl solution, the enhancement was more obvious. $^{3}H_2O$ efflux rate at 10°C showed a slight decrease compared to the rate at 25°C, due to differences in thermal diffusion. Morphologically, at a 1000 rad irradiation, erythrocytes retained a normal shape even 180 min after irradiation. At a 4000 rad irradiation, erythrocytes failed to maintain a normal discoid shape but became crenated. They were regenerated with the addition of inosine and adenine. (auth) (TSS)

47966 EFFECTS OF X-IRRADIATION ON MOUSE LIVER MITOCHONDRIA. 1. Kawasaki, Shoji; Sakurai, Ko (Yamaguchi Univ., Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 28: 1672-6(Mar. 1969). (In Japanese).

Oxidative phosphorylation, adenosinetriphosphatase (ATPase) activity, protein content, and ferrous ion induced lipid peroxide formation in mouse liver mitochondria were observed after whole-body x irradiation (400 rads). In addition, ATPase activity during the swelling and formation of lipid peroxide were studied. The results are as follows: Oxidative phosphorylation decreased while ATPase activity increased at 3 to 6 hr after irradiation, and recovered to the normal level at 24 hr. Protein contents of mitochondria were decreased temporarily after the whole-body x irradiation. Lag period until the formation of lipid peroxide from the addition of ferrous ion, was remarkably accelerated with whole-body x irradiation. In the process of the swelling of mitochondria induced by ferrous ion, at first peroxide was formed in the reaction medium, and DNP-stimulated ATPase activity decreased, and then ferrous ion-induced swelling and Mg-stimulated ATPase activity appeared. Endogeneous ATPase activity occurred at the end of the swelling. (NSA of Japan)

47967 PHYSICAL PRINCIPLES OF THE INTERACTION OF NEUTRONS WITH BIOLOGICAL TISSUES. Winterhalter, D. (Inst. of Physics, Zagreb. Ruder Boskovic Inst., Zagreb). Arh. Hig. Rada Toksikol., 19: 567-77(1968). (In Serbo Croatian).

The properties of neutrons and of neutron radiation consisting of thermal, intermediate, and fast neutrons are reviewed with emphasis on the interaction of neutrons with living tissue. Data on the interaction of thermal and fast neutrons with the principal atoms and isotopes present in living tissue are tabulated. (JPRS)

47968 EFFECTS OF γ IRRADIATION ON COLLAGEN. CHANGE OF PHYSICO-CHEMICAL PROPERTIES OF COLLAGEN BY γ IRRADIATION. Kubota, Minoru; Kimura, Shigeru (Tokyo Univ. of Fisheries). Kikaku Kagaku, 15: 1-7(Apr. 1969). (In Japanese).

The experiment was designed to elucidate the denaturation mechanism of collagen by γ irradiation. First, the velocities of the changes of viscosity and optical rotation of collagen solution were measured and velocity constants were calculated. The relation between the change of reduced viscosity, and irradiation time or between the change of specific optical rotation, and irradiation time was each expressed linearly, but the lines showed a downward bent at a dose of 2.0×10^5R. The velocity constants of the denaturation reaction were tabulated. Below the dose of 2.0×10^5R, the change of viscosity was much greater than that of optical rotation but above it the relation was reversed. When the α-amino group newly-formed by γ irradiation was measured, there seemed to be a definite relation that the amount of α-amino group increased with increasing irradiation dose. It is assumed that the new α-amino group is formed by the scission of peptide chains of the collagen helix by irradiation. The changes of intrinsic viscosity and denaturation temperature (Td) of the collagen by irradiation were found to be related. From the sedimentation patterns, it was observed that although the native collagen having a rigid rod structure showed only a sharp peak, the peak turned to a slightly round shape by irradiation and that huge molecules newly appeared. The sub-unit component corresponding to α or β component as shown in the heat denaturation could not be formed. Therefore even at a dose of 2.25×10^5R where the collagen was assumed to be considerably denatured, the helical structure of the molecule was not completely destroyed. From the above results, it is considered that the denaturation of collagen by γ irradiation is similar to that by uv radiation but differs from that by super-sonic radiation. In other words, the action of γ rays at an early stage of irradiation is assumed to cause a partial scission of the helical chain constituting the collagen molecule, and to cause the collagen molecule

to bend, and the helix is partially loosed in situ. Moreover, it is assumed that as the irradiation dose increases, the helical structure of collagen may proceed to be broken and the free radicals formed by the scission of helical chains may recombine so as to form huge molecules. (F.M.M.)

47969 QUANTITATIVE AND QUALITATIVE CHANGES OF DESOXYRIBONUCLEIC ACID OF THE RADIOSENSITIVE ORGANS IN IRRADIATED MICE. IV. THE EFFECT OF IONIZING RADIATIONS ON THE BIOSYNTHESIS AND CHROMATOGRAPHIC PROFILE OF DNA. Voiculet, N. (CEN, Mol, Belgium); Maisin, J. R.; Ledoux, L. Fiziol. Norm. Patol. (Bucharest), 13: 525-32 (Nov.-Dec. 1967). (In Rumanian).

The effect of x radiation (1,350 R) on the uptake of tritiated thymidine administered in a single dose immediately after exposure to radiation was studied. The degree of incorporation, specific DNA activity, and chromatographic profile on DEAE-cellulose column, were followed up at different intervals (0 to 48 hr) in the intestine, bone marrow, and testicles. The curves of the total radioactivity and of the different intestinal DNA polymerized fractions showed an early and accentuated decrease in the irradiated animals. In the bone marrow the uptake was clearly diminished and DNA chromatography completely disturbed. The results showed that ^{3}H-TdR uptake by different fractions was more deeply involved in the bone marrow. In the testicles the decrease of radioactivity was less evident, but chromatography alterations were noted. The acid soluble fraction increased within the first hours in all the organs studied. (auth)

47970 CHROMOSOMES AND RADIATIONS. Roget, J.; Jobert, J. J. Med. Bordeaux, 144: 149-59(Jan. 1967). (In French).

The normal aspect of human chromosomes and the caryotype is briefly reviewed. The radioinduced anomalies produced during in vitro irradiation are described both with respect to number and structure. Some clinical observations made on physicians afflicted with professional radiodermatitis, tubercular patients who had undergone numerous radioscopic examinations, and on an infant whose mother had received radiotherapy for breast cancer during the sixth month of pregnancy are summarized. In the physicians the numerical anomalies were practically zero but the structural anomalies were numerous. The girl infant had a normal birth, but was soon hospitalized for anorexia, severe weight loss, and neonatal infection. The liver was greatly enlarged in volume. The infant was treated symptomatically in the absence of diagnostic certainty. The recovery was slow. The anomalies visualized by the caryotype during a three-year period were tabulated. After three years the chromosome anomalies are more numerous than at any previous time. (J.S.R.)

47971 STUDIES WITH ESCHERICHIA COLI SEX FACTORS. Freifelder, David (Brandeis Univ., Waltham, Mass.). Cold Spring Harbor Symp. Quant. Biol., 33: 425-34(1968).

From 33rd Cold Spring Harbor Symposium, Cold Spring Harbor, N. Y. See CONF-680631.

The effects of x-radioinduced DNA breakage on the physical properties of the Escherichia coli sex factor (F) were studied using a ^{3}H-labeling technique. An F+ or F′ male cell, incapable of incorporating ^{3}H-thymine, is mated in a growth medium containing ^{3}H-thymine with a thymine-requiring female whose DNA synthesis has been inhibited by uv irradiation. The zonal sedimentation profile of specifically labeled ^{3}H-F′Lac DNA sedimenting through an alkaline sucrose gradient showed a rapidly sedimenting peak moving four times as far as the principal peak and accounting for 9.2% of the total material. If the DNA was x-irradiated to introduce single-strand breaks and then centrifuged through alkaline sucrose, the amount of material in the fast peak decreased. The relation between the fraction of the fast material surviving x irradiation and the x-ray dose is shown. The logarithm of survival was a linear function of dose, indicating that one event (a single-strand break) is sufficient to result in loss of the fast material. The result shows that some of the F′Lac DNA exists in the form of covalently closed molecules. The sedimentation peak of covalently closed DNA molecules in unmated male cells can be eliminated by x irradiation. From 0.5 to 2.5% of the total DNA is in the form of closed circles. Since one single-strand break is sufficient to convert a covalently closed molecule to a nicked circle, the probability that such a conversion will result from a given dose of x rays is proportional to the number of sites in the DNA molecule at which a single-strand break could occur, or to the molecular weight. This proportionality was used to determine the molecular weight of various sex factors. Other x irradiation experiments showed that single-strand breaks were not lethal. (BBB)

47972 ENZYMES INVOLVED IN THE EARLY STAGES OF REPAIR OF ULTRAVIOLET-IRRADIATED DNA. Grossman, L.; Kaplan, J.; Kushner, S.; Mahler, I. (Brandeis Univ., Waltham, Mass.). Cold Spring Harbor Symp. Quant. Biol., 33: 229-34 (1968).

From 33rd Cold Spring Harbor Symposium, Cold Spring Harbor, N. Y. See CONF-680631.

Two enzymes were partially purified from Micrococcus lysodeikticus that together excise photoproduct-containing regions of uv-irradiated DNA. The first enzyme is an endonuclease that produces single-strand breaks in irradiated DNA but does not attack native DNA. The uv-endonuclease activity is absent in certain uv-sensitive mutants of M. lysodeikticus, that are unable to carry out DNA excision in vivo following uv irradiation. Nucleotide release is dependent on the presence of a uv-exonuclease that hydrolyzes single-stranded regions of endonuclease-treated, irradiated DNA. This exonuclease activity is not inhibited by the presence of photoproducts in polynucleotide chains. The combined action of the two enzymes releases ~four to five nucleotides for each phosphodiester bond broken. Most released nucleotides contain thymine. A possible mode for dark repair is offered in which the nucleases described are responsible for the early events in dark repair. The incision step may not be required for the repair of DNA damaged by agents that themselves produce single strand breaks. (auth)

47973 RADIATION SENSITIVITY OF BACTERIOPHAGE DNA. I. BREAKS AND CROSSLINKS AFTER IN VITRO IRRADIATION. Coquerelle, Therese; Bohne, Leuthold; Hagen, Ulrich; Merkwitz, Juergen (Kernforschungszentrum, Karlsruhe, Ger.). Z. Naturforsch., 24b: 885-93(July 1969). (In German).

DNA isolated from Coli bacteriophage T1 was irradiated in 0.165 M NaCl with γ rays. The molecular weight was determined by measurement of the sedimentation coefficient and viscosity. An analysis of the boundary permits the determination of the sedimentation distribution. The distributions of sedimentation coefficients obtained at various DNA concentrations were extrapolated to zero concentration and were transformed into molecular weight distributions. These were used to calculate the weight average molecular weight M_w and the number average molecular weight M_n. The molecular weight of T1-DNA was found to be $32 \cdot 10^6$. After irradiation at a concentration of 200 μg/ml, double breaks as well as intermolecular crosslinks could be determined. The number of double breaks showed a rise with dose that can best be described as composed of a linear and a quadratic term. At low doses the crosslinks increase linearly, the rate being approximately half of that for the linear part of the double breaks. After higher doses, where most of the molecules are degraded, apparently no additional crosslinks are produced. No crosslinks were seen in DNA degraded by DNAase The influence of the DNA concentration on the degradation and the formation of crosslinks is discussed. (auth)

47974 EFFECT OF X-IRRADIATION ON THE RELEASE OF CATECHOLAMINES FROM ISOLATED ADRENAL MEDULLARY GRANULES. Deanovic, Z.; Veninga, T. S. (State Univ., Groningen, Netherlands). Atomkernenergie, 14: 231-4(July-Aug. 1969).

In vitro experiments with isolated storage granules from medullary chromaffin cells of bovine adrenals were undertaken to investigate the effects of radiation on the release of catecholamines (CA). The granules, suspended in isotonic sucrose solution, were irradiated with various doses of x rays under different conditions of temperature and calcium ion concentration. A radiation dose-response relationship was established. The percentage of free CA gradually increased with dose. With a dose of 4000 R seven groups of differently treated granule suspensions were irradiated and the results compared with similarly treated but sham-irradiated samples. The radioinduced release of CA was always present to approximately the same degree. The presence of $CaCl_2$ at 0°C inhibited the release of CA whereas at 38°C $CaCl_2$ stimulated this release. The results strongly indicate a direct temperature and calcium independent effect of x rays on the membrane permeability of chromaffin granules. (auth)

47975 EFFECT ON DNA OF MONOCHROMATIC UV RADIATION IN THE VACUUM. Berger, K. U. (Kernforschungszentrum, Karlsruhe, Ger.). Z. Naturforsch., 24b: 722-8(June 1969). (In German).

Inactivation cross sections of infectious ΦX-174-DNA in the extreme vacuum-ultraviolet were determined by irradiation of thin layers with monochromatic light down to 584 Å by means of a powerful grating-monochromator, the elements of which are described. Comparison of inactivation and light-induced electron emission shows that light of quantum energies below 7 eV inactivates by excitation only, whereas above 10.2 eV ionization is the predominant inactivation mechanism. Because of the satisfactory

agreement of the curves for inactivation and electron emission, it is concluded that the remarkable increase of the inactivation cross section in the region of the short wavelength vacuum-uv is due to increasing ionization probability. (auth)

47976 POSTIRRADIATION CHANGES OF GLUCOSE-6-PHOSPHATE DEHYDROGENASE ACTIVITY IN WHOLE BLOOD HEMOLYSATES. Ahlersova, E.; Ahlers, I.; Praslicka, M. (Safarik's Univ., Kosice, Czech.). Atomkernenergie, 14: 357 (Sept.-Oct. 1969).

Glucose-6-phosphate dehydrogenase from whole blood hemolysates was determined in rats irradiated continuously by ^{60}Co gamma rays at dose rates of 60 R/day up to the total dose of 1500 R, and in rats irradiated by a single x-ray dose of 1500 R. At the end of continuous γ exposure, enzyme activity in hemolysates was significantly decreased. Two and 24 hr after x-ray exposure the decrease of enzyme activity was insignificant. Some implications about the origin of these changes are discussed. (auth)

47977 PHOTOREACTIVATION AND PHOTOREACTIVATING ENZYME ACTIVITY IN AN ORDER OF MAMMALS (MARSUPIALIA). Cook, J. S.; Regan, J. D. (Oak Ridge National Lab., Tenn.). Nature (London), 223: 1066-7(Sept. 6, 1969).

It is stated that direct photoreactivation, defined as the repair of UV irradiated DNA, and hence of DNA dependent functions, by a light independent enzymatic reaction, had not been reported in any mammal. In the studies described both biological photoreactivation and photoreactivating enzyme activity was demonstrated among marsupials. This activity was found in the tissues of the following three species: (a) a kidney cell line from the opossum Caluromys derbianus, (b) two established cell lines from the rat-kangaroo Potorous tridactylis, and (c) primary tissues from the opossum Didelphis marsupialis. Four assays for photoreactivation or photoreactivating enzyme activity were employed, and results are summarized. Every marsupial tissue was positive for photoreactivation activity in every assay by which it was tested. Among the six primary tissues of Didelphis brain and testis showed the highest activity in the transformation assay, and lung showed the lowest. The presence of both a light dependent ability to repair UV damaged DNA and a capacity for biological photoreactivation strongly indicates a causal relationship between the two processes. (UK)

Immunology

Refer also to abstracts 48022, 48091, 48166, and 48196.

47978 CELLULAR DIFFERENTIATION OF THE IMMUNE SYSTEM OF MICE. V. CLASS DIFFERENTIATION IN MARROW PRECURSORS OF PLAQUE-FORMING CELLS. Cudkowicz, G.; Shearer, G. M.; Priore, R. L. (Roswell Park Memorial Inst., Buffalo). J. Exp. Med., 130: 481-91(Sept. 1, 1969).

Marrow cells and thymocytes of unprimed donor mice were mixed in vitro and transplanted into x-irradiated syngeneic hosts, and 18 hr later sheep erythrocytes were injected to induce immune responses. Splenic plaque-forming cells (PFC) secreting IgM (direct PFC) or IgG (indirect PFC) hemolytic antibody were enumerated at the time of peak responses. By transplanting graded and limiting numbers of marrow cells with 5×10^7 thymocytes, inocula were found that contained few precursors of PFC (P-PFC) reaching the recipient spleens, interacting with thymocytes, and generating PFC. However, the frequency of responses in relation to the number of grafted marrow cells did not follow Poisson statistics, presumably because the interaction of marrow cells with thymocytes was more complex than a single or a one-to-one cell event. The frequency of direct PFC responses was greater than that of indirect PFC responses in 13 of 15 groups of mice tested. This was interpreted as evidence for the existence of two classes of P-PFC, each of which was restricted to generate either direct or indirect PFC. The precursors of direct PFC were ~15 times more frequent than those of indirect PFC. Since thymic antigen-reactive cells were not differentiated for antibody class, it follows that antigen-sensitive units reactive to sheep erythrocytes owe their class restriction to specialized marrow cells. Specialization of P-PFC may have arisen within marrow cell lines by differentiation, or may have been conferred upon P-PFC by interaction with other cells, including those of the irradiated host. (auth)

47979 X-RAY IRRADIATION OF THE BLOOD IN EXTRACORPOREAL CIRCULATION AND ITS SIGNIFICANCE FOR HOMOTRANSPLANTATION IN THE RAT. Sanguinetti, F. A.; Gerstmaier, G.; Eisenmann, R.; Waubke, R.; Ruedenholz, A.; Trepel, F.; Pichlmaier, H. (Univ., Munich. Staedische Krankenhauses, Munich). Arch. Klin. Med., 213: 316-27(Sept. 11, 1967). (In German).

In rats, approximately 2000 R x radiation were administered to extracorporeal circulating blood. This treatment was followed by a decrease in lymphocyte count to about one half of the normal value. Several days were required for the radiation effect to disappear. To test the effect of the procedure on immunologic responses, homotransplants of the skin were performed. Extracorporeal blood irradiation four days after transplantation significantly delayed the rejection phenomenon. (H.B.G.)

47980 SUPPRESSION OF ANTIBODY FORMATION BY THE RES-BLOCKADE. 2. EFFECTS OF THE RES-BLOCKADE WITH RADIOACTIVE GOLD COLLOID. Ohbuchi, Shinji (Okayama Univ., Japan). Acta Med. Okayama, 22: No. 2, 113-22(Apr. 1968).

For the purpose of revealing the interaction between macrophages and plasma cells in relation to antibody formation and information for cell specialization, the proliferation of plasma cell by antigenic stimulation was observed in the rats whose RES had been previously injured by radiogold. The production of the circulating antibody was markedly suppressed by the pretreatment with radiogold. Histological observation revealed that the plasma cells and lymphocytes were completely obliterated and the tissues were replaced by the basophilic cells and fibroblast cells. Lymph nodes which contained less radiogold and were expected to show less cell injury had also lost their lymphocytes, but showed a marked proliferation of plasma cells in the medullary cord and large basophilic cells in the area of lymph follicles. The data suggest that the impaired immune response may be due to the failure of the macrophages to release the informational substance for plasma cell specialization and for antibody formation on account of possible inability in metabolizing the ingested antigen by the injured macrophages. (auth)

47981 COMPARATIVE STUDY OF HEMATOPOIETIC CLONE CELLS OF THE BONE MARROW AND OF FETAL LIVER. Duplan, J. F. (Institut du Radium, Paris). Nouv. Rev. Franc. Hematol, 8: 445-56(July-Aug. 1968). (In French).

For a given number of living hematopoietic cells injected, fetal mouse liver cell suspensions produce in the spleen of irradiated recipients, five times fewer clones than suspensions of bone marrow. This difference in efficiency in the production of splenic nodules may be due to one of several factors, namely: erroneous applications of correction factors (e.g., mortality, cell concentration); weak tropism of fetal stem cells for splenic tissue; and limited number of stem cells present in cellular population constituting the hematopoietic fraction of fetal liver. Splenic nodules produced from injected fetal mouse liver differ in cytologic structure from those arriving from bone marrow suspension. When mixed clones are more numerous with the former, pure granulocytic colonies are absent. As the fetus ages, these differences in cytologic composition become less evident. These findings evoke questions of the sensitivity of fetal cells to regulators of differentiation in the adult and the differentiation potential of stem cells relative to their origins. (auth)

47982 SYNGENEIC AND ALLOGENEIC MARROW TRANSPLANTS IN THE CYCLOPHOSPHAMIDE-PRETREATED RAT. Santos, George W.; Owens, Albert H. Jr. (Baltimore City Hospitals). pp 431-6 of Advance in Transplantation. Dausset, J.; Hamburger, J.; Mathe, G. (eds.). Baltimore, Williams and Wilkins, 1968.

From 1st International Conference on Organ Transplantation and Bone Marrow, Paris, France. See CONF-670642.

Marrow transplant studies have usually employed whole-body x irradiation as immunosuppressive pretreatment of the recipient. Cyclophosphamide (CY) is a potent immunosuppressive agent in mice, rats, and man, and its effect was compared with that of x irradiation in marrow transplantation studies. Whole-body x irradiation has the inherent disadvantage related to complex dosimetry considerations that are not easily standardized from one lab to another. CY is a more potent suppressant of antibody formation with less attendant toxicity than x irradiation. No midlethal dose effect was seen in these experiments, nor was it seen in studies utilizing x-irradiated rats as recipients of allogeneic marrow. Classical signs of homologous disease appeared earlier, and in a higher percentage of animals than noted in rat radiation chimeras. The experiments demonstrated that allogeneic marrow may be transplanted to the CY-pretreated rat with attendant classical graft-vs-host disease. For a given cell dose, allogeneic marrow provided as good protection from CY induced lethality as did syngeneic marrow. It was postulated, on the basis of these observations and others in the literature, that CY is more immunosuppressive than the usual doses of whole-body x irradiation used in similar studies. (BBB)

47983 STUDY OF THE PROTECTIVE EFFECT OF CORYNEBACTERIUM PARVUM AGAINST HOMOLOGOUS DISEASE. Howard, J. G.; Biozzi, G.; Stiffel, C.; Mouton, D.; Liacopoulos, P. (Univ. of Edinburgh). pp 457-61 of Advance in Transplantation. Dausset, J.; Hamburger, J.; Mathe, G. (eds.). Baltimore, Williams and Wilkins, 1968.

From 1st International Conference on Organ Transplantation and Bone Marrow, Paris, France. See CONF-670642.

Corynebacterium parvum reduces the mortality from homologous disease in recipients injected with parental strain spleen cells. It causes a proliferation of lymphoreticular cells and stimulates the phagocytic function of the reticuloendothelial system. Mechanism of its inhibitory effect on homologous disease was studied in several strains of mice, some exposed to 500 R of x rays as recipients of spleen cells following injection of C. parvum. Sixty to 80% of C. parvum-treated mice survived homologous disease which was fatal to all control mice. By use of the T_6 chromosome marker it was demonstrated that the proliferation of donor cells was inhibited in the hybrid. The production of antibodies by preimmunized donor cells was also inhibited in the recipient by C. parvum. The protective effect of the bacteria could be abolished by increase of the number of spleen cells injected or by 500-R x irradiation of the recipient 24 hr before injection of the spleen cells. (BBB)

47984 SKIN ALLOGRAFT TOLERANCE INDUCED IN ADULT MICE BY TRANSPLANTATION OF SYNGENEIC MARROW INCUBATED IN VITRO WITH ALLOGENEIC ERYTHROCYTES. Uphoff, Delta E. (National Cancer Inst., Bethesda, Md.). pp 469-73 of Advance in Transplantation. Dausset, J.; Hamburger, J.; Mathe, G. (eds.). Baltimore, Williams and Wilkins, 1968.

From 1st International Conference on Organ Transplantation and Bone Marrow, Paris, France. See CONF-670642.

Lethally irradiated AKR (800 R) or CBA (900 R) mice inoculated with syngeneic bone marrow preincubated 35 min at 75 to 80°F with allogeneic erythrocytes were specifically tolerant to skin allografts from erythrocyte-donor strains. Few CBA mice inoculated with syngeneic marrow preincubated with AKR erythrocytes were protected and survivors developed a severe and lethal secondary disease-like syndrome. CBA marrow preincubated with AKR red cells appeared to be tolerant to AKR recipients producing increased long-term survival but preincubation of CBA marrow with (CBA × AKR)F_1 erythrocytes appeared to sensitize the marrow to the AKR recipient producing a severe and lethal secondary disease syndrome. The mechanisms whereby marrow cells were sensitized or rendered tolerant are discussed. (BBB)

47985 UTILIZATION OF HEMOPOIETIC HETEROCHIMERAS FOR THE REVELATION OF A LEUKEMOGENIC VIRUS. Mathe, G.; Motta, R.; Mery, A. M.; Proenca, M.; Chomette, S.; Sorieul, S.; Muller, N. (Hopital Paul Brousse, Villejuif, France). pp 475-7 of Advance in Transplantation. Dausset, J.; Hamburger, J.; Mathe, G. (eds.). Baltimore, Williams and Wilkins, 1968.

From 1st International Conference on Organ Transplantation and Bone Marrow, Paris, France. See CONF-670642.

The use of radiation rat-mouse heterochimeras to detect a leukemia virus was investigated. Wistar CF, 8-day-old rats were irradiated with 800 rad. On the following day they were injected with bone marrow cells from (DBA/2 × Balb/c)F_1 mice, and on the 6th day, with Friend virus. Most rats died of aplasia and others of the runt disease between days 20 and 50, but in 10% of the leukemia appeared between days 14 and 81. There was a clear evidence in the heterograft of hemopoietic cells since 100% of the bone marrow cells were proven to be mice cells. Other evidence was given that the leukemia cells were of the mouse-type. Preliminary experiments for detecting a human leukemia virus are also described. Newborn animals (4 monkeys, 11 pigs, and 14 dogs) were irradiated with 600 to 800 rad and then injected, on the following day, with 3 to 10×10^9 human bone marrow cells per Kg of body weight. There was no survival beyond the 24th day, but the systematic and comprehensive histological investigation of the animals disclosed that eight of them exhibited at the time of death a regenerating bone marrow, some symptoms of the secondary syndrome (five), and simultaneously a regenerating bone marrow and some signs of secondary syndrome (three). Although preliminary, these results are hopeful and the experiment is being continued. (BBB)

47986 QUANTITATIVE STUDY OF TRANSPLANTATION ANTIGEN IN THE POLYOMA VIRUS–HAMSTER SYSTEM. (MODIFICATIONS BY ULTRAVIOLET RADIATION). Bonneau, H.; Meyer, G.; Lherisson, A. M.; Cesarini, J. P. (Centre Regional de Lutte Contre le Cancer, Marseille). pp 499-501 of Advance in Transplantation. Dausset, J.; Hamburger, J.; Mathe, G. (eds.). Baltimore, Williams and Wilkins, 1968.

From 1st International Conference on Organ Transplantation and Bone Marrow, Paris, France. See CONF-670642.

Polyoma virus induces a transplantation antigen which is transmissible to daughter cells in immunized animals. It was shown that the polyoma transplantation antigen protects hamsters against a large graft of tumor cells (more than 150 times the control dose). It was also shown that this antigen is under the control of the viral genome by uv irradiation studies. The virus was exposed to 2537 Å irradiation at doses of 10,000, 20,000, 30,000, and 40,000 erg/mm^2. With increasing doses of radiation the protective effect of virus against grafted cells was decreased. The results indicated that the antigen which is present on the cell membrane is coded by a fraction of the viral genome much smaller than that coding infectivity by an order of $\sim 1/4$. (BBB)

47987 IMMUNOLOGY OF CARCINOGEN-INDUCED AND SPONTANEOUS RAT TUMORS. Baldwin, R. W.; Barker, C. R.; Embleton, M. J. (Univ. of Nottingham, Eng.). pp 503-5 of Advance in Transplantation. Dausset, J.; Hamburger, J.; Mathe, G. (eds.). Baltimore, Williams and Wilkins, 1968.

From 1st International Conference on Organ Transplantation and Bone Marrow, Paris, France. See CONF-670642.

A program to examine the antigenicities of a range of carcinogen-induced rat tumors is described. These included hepatomas induced by oral administration of 4-dimethylaminoazobenzene (DAB) and diethylnitrosoamine, and 2-acetylaminofluorene-induced mammary carcinomas. Implantation of tumor grafts prevented from progressive growth by exposure to ^{60}Co γ-irradiation (15,000 R) proved highly effective for inducing resistance against rat hepatomas in syngeneic hosts and in only one out of 14 examples tested did the treatment fail to evoke a level of resistance such that a subsequent challenge with 2×10^5 viable cells was rejected. The procedure was also effective for inducing resistance to a diethylnitrosoamine-induced hepatoma. Irradiated tumor grafts were usually implanted three times at 2- to 4-week intervals. In some tests, however, a single implantation of irradiated tumor cells (10^6) evoked significant resistance. Six pairs of rat DAB hepatomas tested showed no evidence of cross-resistance. Resistance to hepatomas could be passively transferred with starch-stimulated peritoneal exudate cells from immune donors. In contrast to the inhibitory effect of sensitized peritoneal cells, sera from immunized rats were either without effect or enhanced tumor growth. Humoral antibody in tumor-immune rats was demonstrated by the indirect fluorescent antibody staining technique. Attempts were made to induce resistance in normal syngeneic hosts against the five spontaneous mammary carcinomas by implantation of heavily irradiated tumor grafts. Irradiated tumor grafts were implanted subcutaneously five times at 2 to 4 weekly intervals. To detect weak levels of resistance treated rats received whole body irradiation (400 R) 24 hr prior to challenge with viable tumor cells. Of the 5 carcinomas tested, significant resistance could be demonstrated with only one. Evidently tumor specific antigens are weak or lacking in some spontaneously arising tumors. (BBB)

47988 NEW DATA ON THE TREATMENT OF LEUKEMIAS AND OTHER TUMORS BY THE GRAFT-VERSUS-HOST REACTION. Schwarzenberg, L.; Mathe, G. (Hopital Paul Brousse, Villejuif, France). pp 549-55 of Advance in Transplantation. Dausset, J.; Hamburger, J.; Mathe, G. (eds.). Baltimore, Williams and Wilkins, 1968.

From 1st International Conference on Organ Transplantation and Bone Marrow, Paris, France. See CONF-670642.

A model system for therapy of leukemia was developed wherein treatment of (DBA/2 × C57Bl/6)F1 mice, carrying L 1210 leukemia, with 500-R total-body irradiation was followed by a graft of C57Bl/6 lymph node cells, fresh or incubated for 1 or 2 hr at 37°C. The results showed prolongation of the survival time of leukemic L 1210 mice, treated with a semi-allogeneic graft of immunocompetent cells, after a 500-rad irradiation. The best result was achieved after a 1 hr incubation. Incubation of immunocompetent cells with the normal antigen did not reduce specifically the incidence of the secondary syndrome without decreasing the antileukemic effect. It was also shown that donor immunization with leukemic cells did not increase the antileukemic effect of immunocompetent semi-allogeneic grafted cells. On the other hand, immunization of C57Bl/6 donors against normal DBA/2 recipient cells enhanced this effect considerably. A slightly smaller effect was achieved for ascitic leukemia by keeping the immunocompetent cells in diffusion chambers. Clinical studies employing these principles are also described. (BBB)

47989 HOSTILE GRAFTS. Van Bekkum, D. W. (Radiobiological Inst. TNO, Rijswijk, Netherlands). pp 565-72 of Advance in Transplantation. Dausset, J.; Hamburger, J.; Mathe, G. (eds.). Baltimore, Williams and Wilkins, 1968.

From 1st International Conference on Organ Transplantation and Bone Marrow, Paris, France. See CONF-670642.

Syngeneic and autologous bone marrow grafts in whole-body ir-

radiated animals and humans are discussed. The treatment of leukemia with whole-body irradiation and syngeneic marrow grafting has been attempted several times. Although a take of the grafted cells may occur in patients that receive a sufficiently large number of cells, the leukemic process is only temporarily arrested. These results were substantiated by quantitative analysis of the effect of radiation on leukemic cell populations in animals, that suggest that doses far in excess of 1000 rad have to be administered to achieve a 90% chance of total eradication of the leukemia, even when the bone marrow contains less than 1% of leukemic cells. Such radiation doses cannot be tolerated because of severe damage to the gastrointestinal tract. However, malignant cells surviving lower doses of irradiation can be successfully and even permanently suppressed by the graft-vs-host reaction which follows the transplantation of allogeneic bone marrow. Hazards of grafting tissues containing immunocompetent cells are referred to. Grafting of hemopoietic cells may carry a severe risk whenever the recipient is immunologically subnormal and therefore an evaluation of the immune status of the recipient should be made prior to treatment, to assess these risks. In cases where the transfer of viable lymphoid cells is not specifically desired, x irradiation of the transplant or the blood with a dose of 1000 rad before its administration can be carried out. (BBB)

47990 SELECTIVE IRRADIATION OF LYMPH NODES AND ITS APPLICATION TO CLINICAL RENAL TRANSPLANTATION. Skikata, T.; Nakane, Y.; Oka, T.; Kodama, M. (Kyoto Prefectural Univ. of Medicine). pp 735-41 of Advance in Transplantation. Dausset, J.; Hamburger, J.; Mathe, G. (eds.). Baltimore, Williams and Wilkins, 1968.

From 1st International Conference on Organ Transplantation and Bone Marrow, Paris, France. See CONF-670642.

Effects of intralymphatic injection of ^{198}Au on lymphocyte counts, antibody response, and renal transplantation in dogs were investigated. Doses up to 0.5 mCi/Kg, diluted to 10 ml, were injected. Relations between dose of injected ^{198}Au and changes in lymphocyte counts in the blood were followed. Lymphocyte counts were 3000 mm^3 in noninjected dogs. In ^{198}Au-injected groups they began to decrease soon after injection, reaching a minimum of 300 to 1500/mm^3 in 3 to 5 days. Such a decrease remained for 2 months. The degree of decrease was parallel with dose up to 0.2 mCi of ^{198}Au and thereafter it was not affected by an increase in the dose of ^{198}Au. Decrease in serum gamma-globulin followed a decrease of lymphocytes. Response to several antigens in the treated animals was reduced. The results of canine renal transplantation are also shown. The interval until rejection of homografts was from 2 to 7 days (4.2 days on an average) in untreated recipients, and from 10 to 23 days (17.8 days on an average) in dogs that had had ^{198}Au injected intralymphatically with the thoracic duct ligated a week before transplantation. Clinical studies are also reported. (BBB)

47991 ADVANCE IN TRANSPLANTATION. Proceedings of the First International Congress of the Transplantation Society, Paris, 1967. Dausset, J.; Hamburger, J.; Mathe, G. (eds.). Baltimore, Williams and Wilkins, 1968. 779p. $37.25. (CONF-670642).

Separate abstracts were prepared for 20 of the reports included in this conference. (M.M.B.)

For abstracts of individual papers see: 47982–47990, 47992–48001, and 48022.

47992 REDUCED MORTALITY FROM SECONDARY DISEASE AFTER EXPOSURE TO HYPOXIA. Congdon, C. C.; Simmons, M. L.; Toya, R. E. (Oak Ridge National Lab., Tenn.). pp 437-9 of Advance in Transplantation. Dausset, J.; Hamburger, J.; Mathe, G. (eds.). Baltimore, Williams and Wilkins, 1968.

From 1st International Conference on Organ Transplantation and Bone Marrow, Paris, France. See CONF-670642.

It was shown that (101 × C3H)F_1 mice exposed to 950-R whole-body x irradiation and then placed in a hypoxia chamber for 2 weeks died at nearly the same intervals (6 to 13 days) as nonhypoxic mice (9 to 13 days). A 90-day mortality study was carried out in which lethally irradiated mice received isologous (IBM) (syngeneic) or homologous (HBM) (allogeneic) bone marrow intravenously within a few hours after exposure. The same day they were placed in the chamber for 2 weeks then removed and kept in regular caging for 90 days. Two weeks of hypoxia was associated with relatively little 90-day mortality in 24 mice given 40 × 10^6 B6D2F_1 bone marrow cells (HBM) compared to a similar group without hypoxia. Mice given 40 × 10^6 isologous bone marrow cells after 950 R and placed in the hypoxia chamber for 2 weeks had a slight increase in 30-day mortality above that usually expected. Some mice kept in these hypoxia chambers showed evidence of central nervous system damage whether they had received irradiation and bone marrow therapy or not. HBM-treated mice with and without hypoxia exposure were sacrificed 8, 10, and 13 days following irradiation. There was a marked reduction in the degree of graft vs host-cell proliferation in lymph nodes and spleen white pulp in animals exposed to hypoxia and examined at these intervals. (BBB)

47993 SUPPRESSION OF ACUTE SECONDARY DISEASE IN THE MOUSE WITH ANTILYMPHOCYTE SERUM. Ledney, G. D.; Van Bekkum, D. W. (Radiobiological Inst. TNO, Rijswijk, Netherlands). pp 441-7 of Advance in Transplantation. Dausset, J.; Hamburger, J.; Mathe, G. (eds.). Baltimore, Williams and Wilkins, 1968.

From 1st International Conference on Organ Transplantation and Bone Marrow, Paris, France. See CONF-670642.

The efficacy of antilymphocyte serum (ALS) as a means by which acute secondary disease can be suppressed was studied. In addition to using the model system to assay the immunosuppressive qualities of ALS, spleen cells were exposed to ALS in vitro before grafting and spleen cell donors were treated with this antiserum. Mice were exposed to either 750- or 875-rad doses of x rays which were 50 and 175 rad above the calculated $LD_{50/30}$ dose for the mice employed. Mice receiving the standard spleen cell graft following either dose of x irradiation were subjected to various treatments with rabbit antimouse lymph node serum (RAMLS). The immunosuppressive efficacy of injection with 0.25 ml RAMLS, as demonstrated by the increase in survival time of free skin grafts in mice differing at the H-2 locus, served as a basis for the selection of this dose for therapy against acute secondary disease. Two doses of RAMLS failed to suppress acute secondary disease. Treatment of the spleen cell donors with ALS was the most effective method by which acute secondary disease was suppressed in irradiated spleen cell inoculated mice. (BBB)

47994 EFFECT OF ANTILYMPHOCYTE SERA ON HOMOGRAFT REACTIVITY AND G-v-H REACTIONS IN RHESUS MONKEYS. Balner, H.; Van Bekkum, D. W.; De Vries, M. J.; Dersjant, H.; Van Putten, L. M. (Radiobiological Inst. TNO, Rijswijk, Netherlands). pp 449-56 of Advance in Transplantation. Dausset, J.; Hamburger, J.; Mathe, G. (eds.). Baltimore, Williams and Wilkins, 1968.

From 1st International Conference on Organ Transplantation and Bone Marrow, Paris, France. See CONF-670642.

The effect of antilymphocyte sera (ALS) on homograft reactivity and graft-vs-host (G-v-H) reactions was studied in monkeys. Bone marrow transplantation was performed after whole-body irradiation. Monkeys were exposed to 770 rad of whole-body x irradiation and given 4 × 10^8 allogeneic bone marrow cells/Kg body weight, 24 hr later. Cynomolgus-anti-Rhesus serum (monkey ALS) produced moderate temporary lymphopenia and a slight prolongation of skin allograft survival if given subcutaneously in very high doses. These sera were well tolerated, also if given intravenously, but the effect on homograft reactivity of intravenous injections was negligible. Both rabbit ALS and ATS (antithymocyte serum) given as a whole serum subcutaneously were highly effective in suppressing homograft reactivity. Doses as low as 3 × 2 ml/Kg of rabbit ATS per week could prevent the rejection of skin allografts as long as treatment lasted. Horse ALS although having a higher in vitro titer, was less effective in suppressing homograft reactivity than rabbit serum (ALS or ATS). Treatment of irradiated recipients of allogeneic bone marrow with rabbit ALS was more effective in suppressing secondary disease than any known immunosuppressive agent; however, virus infections, not seen in nonirradiated ALS treated monkeys, were the cause of death of nearly all chimeras. Doses of ALS necessary to suppress secondary disease were about 10 × those needed to suppress homograft reactivity in nonirradiated monkeys. (BBB)

47995 LOCAL IRRADIATION AND ITS COMBINATION WITH DRUGS IN HOMOTRANSPLANTATION OF ORGANS. Kirpatovskii, I.; Lebedeva, E.; Culic, V.; Bykova, N. (Lab. of Organs and Tissues Transplantation, Moscow). pp 731-4 of Advance in Transplantation. Dausset, J.; Hamburger, J.; Mathe, G. (eds.). Baltimore, Williams and Wilkins, 1968.

From 1st International Conference on Organ Transplantation and Bone Marrow, Paris, France. See CONF-670642.

Effectiveness of local x irradiation combined with systemic use of immunosuppressive drugs in prolonging canine homografts of kidney and intestine was tested. Local x irradiation of the transplant region and regional lymph nodes consisted of 100 to 150 R at intervals between irradiation of one to several days. Total doses of irradiation in homotransplantation of the kidney were 850 R and in homotransplantation of the intestine 200 to 300 R. 6-Mercaptopurine, Imuran, or prednisolone were used as immunosuppressive drugs. The combined treatment led to prolonged takes in homotransplantation of both the intestine and kidney. The maximal time of viability of the intestinal homograft transplanted to the neck was 172 days in comparison with 14 days in the control group. On the

32nd and 70th days the rejection crisis was observed. Comparison of the combined treatment method with only local irradiation revealed greater suppression of the histoincompatibility reaction in the first instance. This was expressed by the absence of morphological changes typical of acute rejection, intensification of fibrosis in the homotransplant, almost complete disappearance of lymphocytes in lymph nodes, and the absence of a plasma-cell reaction, which was present after local irradiation only. (BBB)

47996 INFLUENCE OF THE THYMUS ON ANTIGEN-REACTIVE CELLS AND THEIR PRECURSORS. Miller, J. F. A. P.; Mitchell, G. F. (Walter and Eliza Hall Inst. of Medical Research, Melbourne). pp 79-85 of Advance in Transplantation. Dausset, J.; Hamburger, J.; Mathe, G. (eds.). Baltimore, Williams and Wilkins, 1968.

From 1st International Conference on Organ Transplantation and Bone Marrow, Paris, France. See CONF-670642.

The size of the mobilizable lymphocyte pool was determined in normal and neonatally thymectomized 5- to 6-week-old CBA mice. By establishing a chronic thoracic duct fistula pure populations of lymphocytes could be obtained. The individual number of cells in a pool of thoracic duct lymphocytes capable of reacting to sheep erythrocytes by forming antibodyproducing cells was determined by means of the hemolytic focus assay method. Thoracic duct cells from neonatally thymectomized and sham-operated control mice were injected intravenously into heavily irradiated (1000 rad) adult CBA mice together with sheep erythrocytes. Eight days later, discrete clusters of hemolysin-producing cells were detected in the spleens of the irradiated hosts. With populations of pure small lymphocytes made available by passing thoracic duct cells through a column of tightly packed siliconed glass beads of 50–70 μ in dia, it was shown that small lymphocytes are capable of reacting to sheep erythrocytes. Antigen-reactive cells were capable of proliferating and differentiating to antibody-producing cells as efficiently in thymectomized as in normal mice. Bone marrow cells from 2-month-old normal and clinically healthy neonatally thymectomized CBA mice were injected intravenously into heavily irradiated adult CBA mice (1000 rad) some of which had been thymectomized one week previously. The results indicated that the differentiation and proliferation of marrow-derived antigen-insensitive precursor cells into mature antigen-reactive cells were largely dependent upon some thymus influence. (BBB)

47997 FETAL LIVER CELLS: A SOURCE OF SPECIFIC IMMUNOGLOBULIN PRODUCTION IN RADIATION CHIMERAS. Tyan, M. L.; Cole, L. J.; Herzenberg, L. A. (Naval Radiological Defense Lab., San Francisco). pp 87-9 of Advance in Transplantation. Dausset, J.; Hamburger, J.; Mathe, G. (eds.). Baltimore, Williams and Wilkins, 1968.

From 1st International Conference on Organ Transplantation and Bone Marrow, Paris, France. See CONF-670642.

It was shown that cells capable of producing immunoglobulins are present in the embryonic liver at an early stage of gestation, and that, while these cells are able to produce immunoglobulins in the absence of the thymus, intact thymus function is necessary for the production of specific antibody. Twelve-week-old thymectomized and nonoperated (C57Bl × A)F_1 mice received 870 rad whole-body x irradiation. Immediately thereafter they were given an intraperitoneal injection of nucleated cells from the livers of 14- to 21-day C57Bl/6 × C57Bl/6 embryos. In other experiments the mice received 0.3×10^6 syngeneic bone marrow cells intravenously and an intraperitoneal injection of dissociated gut cells from 14- to 21-day embryos. All mice, thymectomized or nonoperated, which received fetal liver cells had appreciable quantities of donor-type γ_{2A}-globulin in their sera by 58 days postirradiation. All sera tested showed the presence of donor-type γ_1-globulins as well. Immunization with polysaccharide adjuvant of the mice which had received fetal liver cells resulted in specific antibody production in the nonoperated mice only (13/13 vs 0/24 in the thymectomized mice). In this immunized nonoperated group from 10 to 75% of the specific antibody was of donor origin. These results demonstrate that as early as the 14th day of gestation, lymphoid stem cells in the mouse liver are capable of immunoglobulin synthesis in the absence of the thymus. However, their ability to form at least certain specific antibodies is dependent upon intact thymic function. In the absence of the thymus the donor-type immunoglobulins may be "nonsense" or defective antibody-like molecules. (BBB)

47998 THE SELECTIVE TRANSFER TEST: AN ANALYSIS OF THE PRIMARY RESPONSE TO SHEEP RED CELLS. Davies, A. J. S.; Leuchars, E.; Wallis, V.; Sinclair, N. St. C.; Elliott, E. V. (Chester Beatty Research Inst., London). pp 97-100 of Advance in Transplantation. Dausset, J.; Hamburger, J.; Mathe, G. (eds.). Baltimore, Williams and Wilkins, 1968.

From 1st International Conference on Organ Transplantation and Bone Marrow, Paris, France. See CONF-670642.

A method for the analysis of the immune response in allogeneic radiation chimeras is described. Secondary host mice were titrated for serum content of lysins anti-sheep-red-cells 6 days after irradiation and in addition the spleens were taken for plaque counts. CBA/Cbi male or female mice were thymectomized at 8 weeks of age, and 8 to 10 days later were subjected to 850-R total-body x irradiation. Within 3 hr of irradiation mice received 5×10^6 CBA/Cbi femoral bone-marrow cells intravenously. Donors 10 to 12 weeks of age were of the same sex as the recipient. Within 2 hr of injection of bone marrow, mice were grafted with a single lobe of the thymus from a 1- to 2-day-old CBA/HT6T6 mouse. Fifty days after irradiation mice were titrated for natural agglutinins, positive mice were discarded, and spleens of remaining mice containing a mixture of bone-marrow and thymus-derived cells are removed. Spleen cell suspensions were injected into 850-R irradiated secondary host mice (15×10^6 cells/recipient). Secondary host mice were injected with sheep red cells immediately after the spleen cell injection. All secondary host mice were bled 6 days after irradiation and the serum was titrated for anti-sheep-red-cell antibodies. Their spleens were prepared for plaque counts. It was found that all positive responses were dependent on a thymus graft in the primary host. The primary, unlike the secondary immune response, required the participation of cells of thymic origin for it to be detectable as serum antibodies. Thymus-derived cells did not produce antibody. (BBB)

47999 SUPPRESSION OF HOMOLOGOUS DISEASE AND INDUCTION OF TOLERANCE IN A COMBINATION OF ADULT MICE WITH DIFFERENT H-2 LOCUS. Liacopoulos, P.; Herlem, G.; Perramant, M. F. (Hopital Broussais, Paris). pp 183-7 of Advance in Transplantation. Dausset, J.; Hamburger, J.; Mathe, G. (eds.). Baltimore, Williams and Wilkins, 1968.

From 1st International Conference on Organ Transplantation and Bone Marrow, Paris, France. See CONF-670642.

Homologous disease is more severe the greater the genetic disparity between donor and recipient. In x-irradiated recipients homologous disease was modified by pretreatment of donors and establishment of tolerance in a combination of mice in which donors and recipients differed in the H-2 locus. Treatment of CBA(H_2 : k) mice with rabbit γ-globulin inhibited the reactivity of their spleen cells against adult A/J(H_2 : a) recipients x irradiated with 700 R. Mortality of the recipients from homologous disease was thus reduced from 76.3% to 20.6%. Almost all A/J mice which received 25×10^6 or more spleen cells from donors became tolerant towards donor tissue and accepted permanent skin grafts from them. The tolerant mice were true radiation chimeras. Their red cells and lymphocytes were of donor type. The lymphoid cells became specifically tolerant to recipient antigens. Thus, the pretreatment of donors with transplantation antigens can inhibit the graft reaction against the host and promote tolerance in adult irradiated recipients. (BBB)

48000 COLONY-FORMING UNITS IN MURINE RADIATION CHIMERAS. Barnes, D. W. H.; Bland, M. R.; Loutit, J. F. (Medical Research Council Radiobiological Research Unit, Harwell, Eng.). pp 419-22 of Advance in Transplantation. Dausset, J.; Hamburger, J.; Mathe, G. (eds.). Baltimore, Williams and Wilkins, 1968.

From 1st International Conference on Organ Transplantation and Bone Marrow, Paris, France. See CONF-670642.

Lymphocytes in the marrow of syngeneic and allogeneic radiation chimeras made with fetal liver were counted, and other portions of the same marrow suspension were used to perform spleen colony assays. The x-irradiated mice (1000 R) were CBA males 3 to 5 months of age. Shortly after irradiation each recipient was injected intravenously with a suspension of liver cells from fetal mice at 14–18 days of gestation bred by brother-sister mating of CBA/H, C57BL/H, or A/H parents. After various periods surviving chimeras were killed to provide bone marrow for smears and spleen colony assay in further irradiated male CBA/H mice which had received 900 rad. The results indicated that small lymphocytes contribute temporarily to the marrow population following radiation depletion and fetal liver injection. They were in evidence at 14 days in syngeneic chimeras and at 21 days in allogeneic chimeras in proportions approximating normal (about 20%). The proportion then declined along with the development of secondary disease to the much lower figures at 5 and 6 weeks. (BBB)

48001 GROWTH RATE OF CFU POPULATION DETERMINED BY BONE MARROW GRAFT SIZE. Schofield, R.; Pozzi, L. V. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). pp 423-5 of Advance in Transplantation. Dausset, J.; Hamburger, J.; Mathe, G. (eds.). Baltimore, Williams and Wilkins, 1968.

From 1st International Conference on Organ Transplantation and Bone Marrow, Paris, France. See CONF-670642.

It was shown that an increase in the colony-forming unit (CFU): nucleated cell ratio can occur during the splenic recovery from irradiation depletion, and the extent of the increase is dependent upon the number of cells injected when that number of cells is relatively small. Thus, in serial transplantation of the recovering hemopoietic tissue, if the first transfer contained fewer CFU's than the original inoculum the proportions of CFU's in the cells at second transfer was reduced. And when a constant number of spleen cells or a standard volume of tissue was transferred progressively diminishing numbers of CFU's were therefore transferred at each successive transplant. The result was a decline in both the repopulating efficiency and in the protective value. Decline can occur then, not by an intrinsic change in the cell, but by changes in the rate at which the proportion of the CFU increases in different circumstances. Experiments were carried out in $(C_3H \times AKR)F_1$ male mice about 3 months old at the time of irradiation with a total-body dose of 850 rad. Three groups of primary recipients were injected with 10^4, 5×10^4, and 10^5 syngeneic bone marrow cells respectively after 850-rad x irradiation. Between 8 and 13 days later these mice were killed and the spleens removed. Spleen suspensions were injected intravenously into secondary recipients which had been exposed to 850 rad of x rays a few hours previously. (BBB)

48002 EFFECT OF ASSOCIATION OF ALLOGENIC TOTAL BLOOD TRANSFUSIONS OR ALLOGENIC SPLENIC CELLS ON THE RESTORING CAPACITY OF AUTOGENIC BONE MARROW IN 600 AND 1000 RADS, TOTALLY IRRADIATED DOGS. Corneci, I.; Andrian, T.; Costachel, O.; Buzi, E. (Oncological Inst., Bucharest). Atomkernenergie, 14: 229-30(July-Aug. 1969).

The effect of association of fresh allogenic total blood administration or of fresh allogenic splenic cells on the restoring capacity of autogenic bone marrow in 600 and 1000 rad totally teleirradiated dogs was studied. The following experimental groups were used: 600 rads teleirradiated dogs receiving the autogenic bone marrow (harvested before irradiation) 24 h after irradiation. 600 rads teleirradiated dogs infused by autogenic bone marrow and three fresh allogenic totally blood transfusions, (3 × 400 ml), three days consecutively, starting the next day after irradiation (the first transfusion concomitantly with administration of medullar tissue). All the animals in these two groups survived. The third group received the same irradiation dose; 24 h after irradiation and concomitantly with infusion of autogenic bone marrow, all the cells from one allogenic spleen was administered. Out of ten animals, one died on the fifth day. The results obtained under these experimental conditions show that allogenic total blood transfusions do not unfavorably influence the restoring capacity of autogenic bone marrow in dogs. It may be supposed that the organism recognises and prefers its own tissue (autogenic preference). Similar results were obtained with a dose of 1000 rad by corresponding medullary protection. (auth)

48003 THE EFFECT OF ENDOTOXIN TREATMENT ON THE GROWTH AND DIFFERENTIATION OF HAEMATOPOIETIC STEM CELLS. Gidali, Julia; Feher, I.; Varteresz, V. (National Research Inst. for Radiobiology and Radiohygiene, Budapest). Atomkernenergie, 14: 235-6(July-Aug. 1969).

The effects of endotoxin, phytohemagglutinin, and trypsin, respectively on the spleen colony-count of mice irradiated with 750 R and given 10^5 bone marrow cells were studied. Administered in adequate doses and at appropriate times, all the three substances increased spleen colony-count, without affecting their differentiation ratio. In the first days following transplantation the colony-forming cells are refractory to these nonspecific mitogenic stimuli. (auth)

48004 IMMUNE RESPONSES AFTER INTRALYMPHATIC INJECTION OF ^{32}P-CHROMIUM PHOSPHATE IN THE DOG. Toussaint, C.; Kinnaert, P.; Elias, M. (Univ. Libre, Brussels). Europ. Surg. Res., 1: 37-49(1969).

The possible use of selective lymph node irradiation in human renal transplantation was evaluated by examining the tissue distribution of colloidal chromium phosphate-^{32}P following its intralymphatic administration in dogs, the survival of renal allografts, and the immune response to a soluble antigen in treated animals. In 10- to 15-Kg dogs, 3.5 to 5.0 mC of colloidal chromium phosphate-^{32}P (particles size 300 Å) was injected within a lymphatic channel of each hind limb, making a total dose of 7 to 10 mC for each animal. Intralymphatic administration of ^{32}P was followed by profound and persistent depression of the absolute blood lymphocyte count in the blood. Lymphopenia persisted as long as 85 days, and even up to 260 days in 1 animal. Leucocytosis, hemoglobin concentration, and hematocrit values remained normal, except for a transient rise in total white cells count, 24 to 48 hr after ^{32}P administration. Destruction of directly exposed lymph nodes was seen, and variable degrees of lymphocyte depletion in remote lymph nodes and spleen. Radiophosphorus uptake was extremely high in liver, spleen, and in directly exposed lymph nodes, but negligible in bones, lungs, and remote lymph nodes. These results suggest that lymphopenia and lymphocyte depletion in remote lymph nodes are caused by irradiation of the blood within the liver. In ^{32}P-treated dogs, the synthesis of antibodies against human serum albumin was deeply depressed, but this immunodepressive therapy did not prolong kidney allograft survival. The hepatic lesions observed in these irradiated dogs contraindicate the use of ^{32}P as on immunodepressant in human organ transplantation. (BBB)

Ecology

Refer also to abstracts 48030 and 48290.

48005 (ORO-3238-7) FIELD EXPERIMENTS ON THE FLUX OF RADIONUCLIDES THROUGH A SALT MARSH ECOSYSTEM. Progress Report. Pomeroy, L. R.; Odum, E. P.; Reimold, R. J.; Jones, R. D. H.; Shenton, L. R. (Georgia Univ., Athens. Dept. of Zoology). Sept. 25, 1969. Contract AT(40-1)-3238. 24p. Dep. CFSTI.

During the 1969 contract year the flux of ^{32}P from the sediments through Spartina alterniflora, and its subsequent release into the salt marsh ecosystem were evaluated. Related field experiments have been concerned with the flux of ^{32}P, ^{65}Zn, ^{90}Sr, and ^{59}Fe through the five compartments identified in our mathematical model. Mathematical modeling efforts have been directed toward digital, analog, and digital-analog hybrid computer solutions as well as analytical solutions. Effects of inputs and outputs in the five compartment model have been considered as well as the effect of perturbations of the standing stock values. The model appears to respond closely to natural environmental measurements and consequently can be expanded in complexity to include a greater number of compartments and nonlinear flux rates. (auth)

48006 (UCLA-12-724) SEMIANNUAL PROGRESS REPORT FOR THE PERIOD ENDING JUNE 30, 1969. (California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology). Contract AT(04-1)-Gen-12. 87p. Dep. CFSTI.

Research accomplishments during January 1, 1969, through June 30, 1969, at the University of California's nuclear medicine and radiobiology laboratory are presented. The research projects are divided into five categories including: Environmental Radiation, Biochemistry, Biophysics, Nuclear Medicine, and Radiobiology. Separate abstracts were prepared for each of these categories. A list of publications during the report period is also included. (E.R.B.)

For abstracts of individual sections see: 47739, 47953, 47954, 48007, and 48091.

48007 (UCLA-12-724, pp 1-21) ENVIRONMENTAL RADIATION. (California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology).

Interim and final reports are presented for 19 studies conducted by the Environmental Radiation group. The 19 studies include: Studies of natural populations of Crotaphytus wislizenii; Home ranges of lizards in Rock Valley; Spurious thermoluminescence of soils; Influence of soil organic matter on ^{137}Cs uptake by barley seedlings; Influence of fallout irradiation and environmental factors on vegetation of the Nevada Test Site; Effect of the phosphorus level on the micronutrient content of Franseria dumosa; Sodium relations in some desert plants; Effects of soil temperature on behavior of some shrub species from northern Mojave Desert; Propagation of shrub species from the Mojave desert and adjacent areas; Radiochemical support; The variation in the water extractable cations in soil as a function of high γ dose rates; The behavior of Mn(II) in a system between bis(2-ethylhexyl) hydrogen phosphate and aqueous nitric acid; Cs, K, Sr, and Ca transport in two different plant species; Monovalent ion carrier effects on transport of ^{86}Rb and ^{137}Cs into bush bean plants; Ecology of the Nevada Test Site; Effects of low level chronic γ radiation on the population dynamics of desert rodents; Radiation sensitivity of rodent species; Mortality rates in irradiated rodent populations; and Studies of the home range of desert rodents. A list of publications for the current report period is also given. (E.R.B.)

Genetics and Cytogenetics

Refer also to abstracts 47986, 47999, 48045, 48192, 48244, 48255–48258, 48260, 48276, 48277, 48280, and 48281.

48008 (NYO-2043-194) THE APPLICATION OF NUCLEAR ENERGY TO AGRICULTURE. Annual Report. Moh, Carl C.

(Inter-American Inst. of Agricultural Sciences, Turrialba (Costa Rica)). July 1, 1969. Contract AT(30-1)-2043. 113p. Dep. CFSTI.

Separate abstracts were prepared for five of the papers presented in this report. Other papers discuss studies in biochemistry, plant physiology, entomology, and soil chemistry. (E.R.B.)

For abstracts of individual papers see: 48009–48011, 48254, and 48289.

48009 (NYO–2043-194, pp 5-12) THE GENETIC BEHAVIOR OF THE MUTANTS INDUCED BY ETHYL METHANESULFONATE IN THE COMMON BEAN (PHASEOLUS VULGARIS L.). Moh, C. C. (Inter-American Inst. of Agricultural Sciences, Turrialba (Costa Rica)).

Analysis of more than 200 mutant lines of Phaseolus vulgaris induced by EMS as compared with more than 100 mutant lines induced by acute γ irradiation of seeds revealed no significant differences with respect to: the proportion of chlorophyll to morphological mutants; the genetic behavior of the mutations; or the mean value of the mutants segregated by the mutual line. However, exposure of the plants to chronic irradiation during their entire life cycle, resulted in a difference in the induced mutations relative to the genetic aspects mentioned above. (E.R.B.)

48010 (NYO–2043-194, pp 12-17) EFFECTIVENESS OF GAMMA RADIATION AND ETHYL METHANESULFONATE IN INDUCING SEED COAT COLOR MUTANTS IN THE COMMON BEAN AND THE GENETICS OF THE INDUCED WHITE SEED COAT MUTANTS. Moh, C. C. (Inter-American Inst. of Agricultural Sciences, Turrialba (Costa Rica)).

The ability of γ radiation or EMS to induce seed coat color mutants in Phaseolus vulgaris was investigated. The results indicated that both mutagenic agents were successful in inducing the desired mutations. During the investigation, a white seed coat mutant was obtained using both EMS and γ rays. It was determined that the white seed coat mutants were the result of a change of the dominant P factor. (E.R.B.)

48011 (NYO–2043-194, pp 43-52) PHYSIOLOGICAL STUDIES ON THE RADIATION-INDUCED DWARF BEAN MUTANT. Morales, C.; Greene, G. L. (Inter-American Inst. of Agricultural Sciences, Turrialba (Costa Rica)).

Studies were initiated to identify the specific mechanism responsible for the reversal of dwarfism in dwarf-1 mutants of Mexican 80-R beans. To accomplish this, neutral fractions of mature seeds of dwarf-1 and normal lines were analyzed chromatographically and the results compared. Individual spots from the chromatograms were then isolated and tested in one of the dwarf bean or lettuce seedling tests. It was postulated that the neutral fraction from the normal plant contained factors regulating stem elongation and leaf expansion that were absent in the fractions from dwarf plants. Current investigations revealed that all factors present in the normal fraction were also present in the dwarf fraction, but that the dwarf fraction contained in addition, an inhibitor of endogenous gibberellin activity. (E.R.B.)

48012 (NYO–2740-6, pp 238-54) RBE STUDIES WITH MONOENERGETIC NEUTRONS. GENETIC EFFECTS ON DROSOPHILA. Gonzalez, F. W. (Columbia Univ., New York. Radiological Research Lab.).

The results of a series of experiments to determine the RBE of 0.68 MeV neutrons and x rays for sex-linked recessive lethal mutations in Drosophila melanogaster are presented. The RBE value in this case was 0.3. Another experiment, designed to determine the dose-response relation preliminary to determining the RBE for neutrons and x rays, was conducted. In this experiment, the frequency of translocations between the second and third chromosomes of D. melanogaster was measured following exposure to five doses of x rays. The frequence of translocation increased as the 1.5 power of the dose rather than the square of the dose. An experiment is currently underway to determine whether translocation mosaics could be produced by neutrons. In this experiment, six-day-old male flies were irradiated to a dose of 2000 rads of fission neutrons. No data are as yet available on this study. Another series of experiments was conducted to determine whether x-ray injured sperm were able to fertilize eggs as readily as undamaged sperm. Using the frequency of translocations between second and third chromosomes as a determinant, if was found that if females were allowed to lay eggs for six days, such a bias would not occur. In a related experiment, concern that bias could exist due to the fact that later eclosing flies would have a higher probability of carrying a radioinduced lesion than early eclosing flies, was found to be unjustified. (E.R.B.)

48013 (NYO–2740-6, pp 255-68) RBE STUDIES WITH MONOENERGETIC NEUTRONS. EXPERIMENTS WITH TRADESCANTIA INFLORESCENCES. Underbrink, A. G. (Columbia Univ., New York. Radiological Research Lab.).

A series of experiments were conducted to determine: the RBEs of the radioinduced effects of 0.43 to 15 MeV neutrons; whether correlations exist between chromosome or nuclear volume and the radioinduced effects in different species; and whether the physical data obtained through microdosimetry will correspond to known biological entities. The following results were obtained from irradiation of immature buds of Tradescantia inflorescences with 0.43 MeV neutrons. Following irradiation, the cuttings were grown in Hoagland's solution in controlled growth chambers and results scored at seven to 25 days postirradiation. When the logarithmic of % pollen survival after day 18 postirradiation was plotted against dose, the slope approximated a straight line. The correlation of number of petal mutations to dose was nonlinear. This was explained by the fact that at high doses, cell death occurred and thus fewer mutant sectors were present for a given petal. The same is true for the nonlinear relation between incidence of stamen hair mutations and dose. In studies designed to determine the relation between stamen hair stunting and target volume (chromosome), the results, though preliminary, indicate that the theoretical target volume corresponds with the volume of the interphase chromosome. (E.R.B.)

48014 (NYO–2740-6, pp 269-302) RADIATION EFFECTS ON BACTERIA AND BACTERIOPHAGE. Hill, Ruth F. (Columbia Univ., New York. Radiological Research Lab.).

When cells of hcr^- WP2 were uv-irradiated on TTC mannitol agar, sectored colonies were produced. Retraction of the colony edge occurred in some sectored colonies. To determine whether the new cell types resulted from the combined action of radiation and dye or from radiation alone, irradiated cells were plated on nutrient broth-mannitol agar without TTC. Twenty-four hrs later, the colonies were overlayed with agar containing TTC. Sectoring occurred within the hour, indicating that the sectoring did not require immediate exposure of irradiated cells to dye. Samples of phr^+ hcr^- strain were uv-irradiated and then photoreactivated for 25 min. The results indicated that dimers were primary lesions in the sectoring phenomenon that occurred only at small doses. Strains exr^+ and exr^- were aerobically x-irradiated, and sectored colonies were found only in the exr^+ strain. When production of sectored colonies was compared at the same survival level of an exr^+ strain, x rays proved to be less efficient than uv radiation. In studies of the stability of variant, it was shown that the dose-effect relation was the same for both stable and unstable variants induced either by uv or x rays. Instability in the sectors could be eliminated by growth of the unstable strains on broth containing acriflavine. The relation between the shape of the uv survival curve and the Fil^+ phenotype was studied. Also, the effects of acriflavine on the shape of the survival curve of Fil^+ organisms were determined. (E.R.B.)

48015 (SAN–529-12) RADIATION RESISTANCE OF DROSOPHILA LARVAE. Three Year Comprehensive Report. (San Diego State Coll., Calif.). [1969]. Contract AT(04-3)-529. 59p. Dep. CFSTI.

Selection experiments for increasing resistance of larvae to x radiation were conducted. Beginning with the ninth generation tests were initiated to determine the survival of hybrid larvae formed by crosses between flies from the resistant and sensitive lines. The results indicated that the genes responsible for the reduction in survival of the sensitive line are probably recessive with some expression in the heterozygote. Studies on the relationship between radiosensitivity and the rate of development in x-irradiated larvae indicated that development was slower in the more sensitive line. Studies on the relationship between age and chromosome segregation included determination of frequency of chromosome detachment and non-disjunction in irradiated and aged stage 7 and 14 oocytes, determination of frequency of chromosome gain and loss when both parents are aged or irradiated, and non-development when irradiated males are mated immediately or aged three weeks. Other studies were conducted on relationship between chromosome puffing patterns and x irradiation in Drosophila larvae; mutation induction in Drosophila cultured on irradiated medium; characterization of radiation resistant and sensitive lines by means of offspring per brood in the two lines, relative viability and productivity, and calculation of lethal equivalents; mutation induction by environmental mutagens; and effects of pesticides on mutation frequency in natural populations of Drosophila melanogaster. (H.L.W.)

48016 LETHAL AND MUTAGENIC LESIONS INDUCED BY IONIZING RADIATIONS IN E. COLI AND DNA STRAND BREAKS. Munson, R. J.; Bridges, B. A. (Medical Research Council, Harwell, Eng.). Biophysik, 6: 1-5(1969).

The inactivation doses for Escherichia coli exposed to alpha

particles and protons of different LETs and to gamma rays have been measured. Strains derived from E. coli B/r showed a maximum sensitivity at LETs of ~30 keV/μ while B_{s-1} and other strains known to be deficient in repair capacity had sensitivities which decreased monotonically with increasing LET. These results can be interpreted in terms of two types of lethal damage to the bacterial genome. Damage of type 1 affects only one strand of the DNA macromolecule and is partially reparable in vivo while damage of type 2, inflicted by one track intersection of the DNA, is irreparable. The identity of both types of damage is uncertain but type 1 probably gives rise to a lesion recognizable in vitro as a single strand break. Type 2 damage probably corresponds to double strand scission of DNA as observed in vitro. Mutations to prototrophy of three auxotrophic strains of E. coli are induced with an effectiveness which decreases steadily with increasing LET. This form of LET dependence implies that these mutations involve damage to one target only, probably one strand of the DNA duplex. (auth)

48017 THE EFFECTS OF GAMMA RAYS ON APPLE AND PEACH LEAF BUDS AT DIFFERENT STAGES OF DEVELOPMENT. Lapins, Karlis Otto. New Brunswick, N. J., Rutgers–The State Univ., 1968. 127p.

Thesis.

In the search for efficient methods of artificially inducing and selecting useful mutants in fruit trees, attempts were made to relate detectable mutants to developmental stages of irradiated leaf buds and to the portion of the irradiated plant that is likely to give the highest yield of mutants. Young seedlings from embryo culture and leaf buds at different stages of development in apple and peach were subjected to various exposures of gamma rays from ^{60}Co sources using different dose rates. Mutants in morphology and in deficiencies of anthocyanins and chlorophyll of the leaf were recorded in primary and secondary shoots originating from irradiated buds. The extent and type of radiation injury and the course of recovery of meristematic tissue were studied in shoot apices. Relatively high mutation frequencies were obtained following the irradiation of forced winter buds in apple and actively growing seedlings in peach. Conditions favoring extensive division of cells immediately after irradiation appeared to assist mutated cells in competition with non-affected cells. Using acute exposures ranging from 2.0 kr to 3.5 kr, the greatest frequency of mutants was produced in the zone of the primary shoot which included the shoot apex with the youngest primordia of leaves and of axillary buds. Doses of 5.0 kr to 6.5 kr and high dose rates resulted in high mortality, large sectors of mutated tissue, and concentration of mutants in the area of the primary shoot where axillary buds had been partly developed at the time of irradiation. Exposures of buds to gamma rays in the range of 3.5 kr to 5.0 kr administered at the rate of 800 R per min combined over 50% survival of plants with relatively high rates of mutations. Survival was remarkably influenced by environmental conditions following irradiation. Dose rates affected both the survival and the rate of initial growth, an indication that chromosomal damage was involved. In peach seedlings, the LD_{50} values were: 15 kr at the rate of 12 R/min and 3.7 kr at 800 R/min. (Diss. Abstr.)

48018 EFFECTS OF MICROIRRADIATIONS ON THE MICROSPOROPHYTES AND MICROSPORES OF TRADESCANTIA PALUDOSA. I. THE MEIOSIS IN THE MICROSPOROPHYTES IN VITRO. Garot, G.; Lebrun-Peremans, J.; Moreau, L.; Gilles, A. (Univ. Catholique, Louvain, Belg.). Can. J. Genet. Cytol., 10: 44-9(Mar. 1968). (In French).

Meiocytes of Tradescantia paludosa are cultivated under the microscope in a simple medium. Phase-contrast observation of the chromosomes is very accurate, from metaphase I to telophase II. Such living material is very convenient for the study in vitro of the effects of micro-beam irradiation. (auth) (CANADA)

48019 RECIPROCAL TRANSLOCATIONS INDUCED BY X-RAYS AND THERMO-NEUTRONS IN WILD SORGHUM (S. PURPUREO-SERICEUM ASCHERS AND SCHWEINF.). Wu, T. P.; Pi, C. P. (National Taiwan Univ., Taipei). Can. J. Genet. Cytol., 10: 152-60(Mar. 1968).

Dry seeds of S. purpureo-sericeum were irradiated with either x rays or thermo-neutrons with three exposures each. No difference was shown in germination between the irradiated treatments and the control. The percentage of survival was greatly reduced to 2.2% in seeds treated with x rays. However, there was no significant difference in survival between the thermo-neutron treatments and the control. Both radiation treatments inhibited seedling height to a considerable degree, and the variability of seedling height increased with higher exposures of irradiation. The types and the frequency of induced interchanges were proportional to the exposure of thermo-neutron irradiations. Twenty-six translocation heterozygous plants were analyzed and considered to be semisterile plants. Spore quartet analysis revealed that the two types of adjacent segregations occur with nearly the same frequency. Six plants with pseudo-isochromosomes were detected. Pseudo-isochromosomes were often delayed in anaphase movement. They were excluded from daughter nuclei at telophase stages and eventually became micronuclei in the spore quartets. Two plants with a ring-of-six, and one plant with two pseudo-isochromosomes plus a ring-of-six were also found among the materials irradiated with high exposures of thermo-neutrons. Pollen counts showed that they had the lowest fertility among translocation heterozygous plants and no seed was obtained. (auth) (CANADA)

48020 ULTRASTRUCTURAL STUDIES OF RADIATION-INDUCED CHROMOSOME DAMAGE. Humphrey, Ronald M.; Brinkley, B. R. (Univ. of Texas, Houston). J. Cell Biol., 42: 745-53(Sept. 1969).

The fine structure of radioinduced chromosome aberrations in Potorous tridactylis (rat kangaroo) cells was examined in situ by electron microscopy. The observations on the structure of terminal deletions (acentric fragments), anaphase bridges and gaps, sidearm bridges, and specialized regions, such as the nucleolus organizer, are discussed in detail. Conclusions based on these observations are the following: damage is physically expressed only at anaphase; a gap region is composed of two subunits, each of which is about 800 to 1000 Å in diameter and may correspond to a half-chromatid structure; the ends of acentric fragments are structurally similar to normal chromosome ends, except where the break occurs in a specific region such as the secondary constriction; at metaphase the fragment and the main portion of the chromosome move as a single unit to the equator, and the two units are disconnected only at the onset of anaphase; and sidearm bridges appear to be exchanges, involving a subchromatid unit. The interpretation of this evidence is consistent with the hypothesis that the chromosome is a multistranded structure. (auth)

48021 A MALE STERILE PEPPER (C. ANNUUM L.) MUTANT. Daskaloff, Stefan (Inst. of Genetics and Plant Breeding, Sofia). Theor. Appl. Genet., 38: 370-2(1968).

After treatment of dry seeds of red peper (Capsicum annuum) with 4 to 22 kR of x rays, a male-sterile mutant was discovered in the M_2 generation. The male-sterile mutant segregated in a ratio of 3.28:1. After an alternative cultivation of male-sterile plants and of a variety with good combining ability, relatively good fruit-setting and seed production was obtained. Grafting of male-sterile scions to normal stocks did not affect the male-sterile phenotype. The male sterile plants grew normally and do not differ from the initial variety in general features, but the male sterility was present both under greenhouse and field conditions. Grafting of male sterile scions on normal stocks did not influence male sterility. It was concluded that the male sterility was determined by recessive gene. No pleiotropic effect of this gene for male sterility was observed, and there was a slight tendency of the heterozygous plants to bloom earlier. (BBB)

48022 FACTORS THAT MODIFY POOR GROWTH OF PARENTAL MARROW CELLS IN F_1 HYBRID MICE. Goodman, Joan Wright; Wheeler, H. Brownell (Oak Ridge National Lab., Tenn.). pp 427-30 of Advance in Transplantation. Dausset, J.; Hamburger, J.; Mathe, G. (eds.). Baltimore, Williams and Wilkins, 1968.

From 1st International Conference on Organ Transplantation and Bone Marrow, Paris, France. See CONF-670642.

The growth of parental marrow cells in irradiated F_1 hybrid mice was studied under a variety of experimental conditions. The basic experiment consisted of transplanting a small dose of parental bone marrow (10^6 cells) into heavily irradiated F_1 hybrid mice. Assessment of success of the marrow transplant was based on erythropoiesis after 1 week, as measured by 24-hr ^{59}Fe uptake by erythrocytes and spleens. Poor growth of parental marrow could be modified by pretreatment of the hybrid with spleen slice grafts or with other preparations of viable, immunologically competent parental cells, isogenic with the subsequent marrow graft. Old parent-to-F_1 chimeras were reirradiated (900 R), and the growth of 10^6 parental marrow cells was assessed 1 week later. Even when a reirradiated chimeric host was unrelated to the marrow donor, parental cells grew well if the original transplant was parental, but poorly if it was F_1. In another experiment, 10^8 dead (exposed to 10,000 R in vitro) isogenic parental cells were added to the living parental bone marrow inoculum (10^6 cells). There was no pretreatment prior to irradiation. Parental spleen cells made incapable of division, but morphologically intact, produced a highly significant augmentation of growth of 10^6 living parental marrow cells, when given intravenously either 3 hr before or mixed together with the viable inoculum. Any procedure that provided a large number of morphologically intact parental cells in the F_1 host

at the time of irradiation and marrow transplantation markedly potentiated the take of a parental marrow graft. (BBB)

48023 ULTRAVIOLET-INDUCED MUTATIONS TO GROWTH FACTOR REQUIREMENT AND PENICILLIN RESISTANCE IN A BLUE-GREEN ALGA. **Srivastava, B. S. (Banaras Hindu Univ., India). Arch. Mikrobiol., 66: 234-8(May 21, 1969).**

Isolation and characterization of two mutant strains of the blue-green alga, Phormidium mucicola, induced by uv irradiation are described. The cells of P. mucicola growing exponentially in the basal medium were exposed to uv radiation at a distance of 24 cm from a General Electric germicidal lamp emitting mainly at 2537 Å, for an exposure of 9.6×10^3 erg/mm^2/min. After an initial 3-min uv treatment of the parent population, more colonies grew on a supplemented media than on the basal medium. The colonies appearing on supplemented media were grown singly in various liquid media, and 1 isolate, designated as 3 mL, served as parent for further uv treatments. After subsequent exposures to uv, two mutant strains that were stable and inheritable were isolated. Strain 5/5 mL-1 is a photoheterotrophic mutant requiring addition of an organic growth factor to the basal medium that appears fulfilled by either case in hydrolysate, glucose, acetate, or vitamin mixture and fails to grow heterotrophically. The second mutant, mr/p, shows resistance up to 10.24 μg/ml of penicillin whereas the parent does not survive beyond a penicillin dose of 0.1 μg/ml. (BBB)

48024 DDT RESISTANCE IN BARLEY, HORDEUM VULGARE. I. INDUCED MUTANTS FOR RESISTANCE. **Wallace, A. T.; Rillo, F. O.; Browning, R. M. (Florida Agricultural Experiment Stations, Gainesville). Contract AT(40-1)-3092. Radiat. Bot., 8: 381-8(Dec. 1968). (ORO-3092-18).**

Most barley cultivars are susceptible to DDT; resistance is recessive and is dependent on one or two pairs of genes. Resistant mutants were induced with γ rays and ethylene imine in a susceptible biotype. The M_2 mutant seedling frequencies for 10 krads and 20 krads of γ rays were 6.35 and 12.20 ($\times 10^{-5}$), respectively. The frequencies for 0.68 and 0.08% ethylene imine were 18.72 and 28.96 ($\times 10^{-5}$), respectively. These data, along with the frequencies of chlorophyll mutations observed, suggested a mutagen–locus specificity response. The degree of resistance for 124 mutants was determined by measuring the chlorophyll content in treated leaf tissue. This classification showed that some of the mutants were only partially resistant, ranging from almost completely resistant to fully susceptible. Segregation ratios of progenies from crosses of the mutants to the susceptible parent indicated that, in most cases, the mutation does not reduce its gametic transmissibility. The segregation data and the reduction in chlorophyll content of treated leaf tissue suggested that some of the mutants were temperature sensitive and that possibly more than one type of gene action was responsible for resistance. (auth) (UK)

48025 EVIDENCE FOR SUBCHROMATID ORGANIZATION IN MARSUPIAL CHROMOSOMES. I. LIGHT AND ELECTRON MICROSCOPY OF X-RAY-INDUCED SIDE-ARM BRIDGES. **Brinkely, B. R.; Humphrey, Ronald M. (Univ. of Texas, Houston). J. Cell Biol., 42: 827-31(Sept. 1969).**

Since the structure of the side-arm bridge observed in rat kangaroo cells may have significance in interpreting the organization of metazoan chromosomes, the ultrastructure of radioinduced side-arm bridges was investigated in detail. Cultured rat kangaroo cells were x-irradiated to 250 rad at a dose rate of 180 rad/min, incubated at 37°C for 30 min, and then prepared for electron and light microscopy. The results indicated that the initial aberration apparently involved a subchromatic unit. These data along with DNA replication data lend support to the hypothesis that plant and animal chromosomes are multistranded and composed of more than a single DNA complex. (E.R.B.)

48026 GENETIC CONTROL OF PATTERN DETERMINATION IN DROSOPHILA. II. NONRANDOM DISTRIBUTION OF MOSAIC TISSUES. **Gottlieb, Frederick Jay (Univ. of Pittsburgh). Genetics, 62: 135-44(May 1969).**

Genetic mosaics, produced by the x irradiation of Hw^{49c}sn^3/y and of sn^3/y, Iso (2:3) female Drosophila melanogaster and classified with respect to the location of thoracic tissue patches, were analyzed to determine whether alternative homozygous tissue twin spots are randomly distributed on the surface of the thorax and whether the position of one tissue patch affects the location of its twin. The results indicate that twin patches are not always randomly distributed on the thoracic surface. Hw^{49c}sn^3/Hw^{49c}sn^3 (and also sn^3/sn^3) tissue patches have a greater tendency to locate themselves within the dorsocentral region of the thorax than do their y/y twins. Hw^{49c}sn^3/Hw^{49c}sn^3 tissue patches were shown to affect the size of y/y patches lying medial to them in the dorsocentral region. Single spot mosaic data were also presented which indicate that there are fewer y/y single patches recovered than either sn^3/sn^3 or Hw^{49c}sn^3/Hw^{49c}sn^3 patches. (auth)

48027 A SYSTEM FOR SCREENING OF RARE EVENTS IN GENES OF DROSOPHILA MELANOGASTER. **Lifschytz, Eliezer; Falk, Raphael (Hebrew Univ., Jerusalem). Genetics, 62: 343-52(June 1969).**

The construction of an efficient screening system for the detection of intracistronic recombinants and of back mutants in Drosophila is described. The system utilizes the specific lethal interaction of pn and K-pn, in combination with criss-cross lethals in an X chromosome segment covered by a marked Y chromosome. No recombination between various pn alleles was obtained in over 4×10^6 zygotes. Revertants of pn and K-pn were obtained at frequencies similar to those of spontaneous forward mutations. The reasons for the absence of pn-recombinants was discussed. The possibility that intra-cistronic recombinants are rarer, per physical distance, than most recombinants in complex loci systems, which were due to inter-cistronic events, was considered. (auth)

48028 A GENETIC ANALYSIS OF THE KILLER-PRUNE (K-pn) LOCUS OF DROSOPHILA MELANOGASTER. **Lifschytz, Eliezer; Falk, Raphael (Hebrew Univ., Jerusalem). Genetics, 62: 353-8(June 1969).**

In screening experiments for rare spontaneous events at the pn and K-pn loci, prune flies were detected at a frequency of 1.7×10^{-6}. The fertile flies were shown to be due to genetic events at the K-pn locus. EMS was less efficient in the induction of such reversions of K-pn than were x rays. All revertants were recessive lethals and all these lethals were allelic. The revertants were presumed to be deletions of the K-pn locus. It was concluded that the K-pn$^+$ gene has a vital function which was not lost when the K-pn mutation occurred. The K-pn mutant was found to be neomorphic. (auth)

Health Physics and Safety

Refer also to abstracts 47815, 48230, and 48250.

Radioactive Contamination and Decontamination

Refer also to abstracts 47663, 47926, 48042, and 48043.

48029 (CEA-tr-A-1957) RESEARCH ON THE TECHNIQUES OF DECONTAMINATION OF WATER RETAINED BY DAMS WITH THE INSTALLATION OF RAPID FILTERS. **Bernhardt, H.; Hartmann, H.; Baumgaertel, F. Translated into French from German report. 37p. (In French). Dep.**

The methods investigated for the decontamination of the filtration installation included flocculation with Al and Fe salts and precipitation with phosphates. Iron chloride in an alkaline medium was found to be more suitable for the extraction of nuclides than Al sulfate. The efficiency of phosphates for decontamination was increased by raising the value of the pH. Aluminum hydroxide was found to be a better extractant for ^{144}Ce than for ^{89}Sr. The possibility of the use of flocculation with an addition of flocculant of 60 mg/l was verified in a rapid filtration installation. (P.C.H.)

48030 (EUR-4272) RADIOACTIVITY CONTAMINATION LEVELS IN THE ENVIRONMENT AND IN THE FOOD CHAIN. Annual Report, 1967. **(Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Dec. 9, 1968. 54p. (In French). Dep. CFSTI (U. S. Sales Only).**

During 1967 the Euratom/CEA Association continued its work in the following fields: In human biology, the study of the physiological factors and their evolution as a function of age was extended. The investigation of iodine and strontium metabolism is now supplemented by research on the metabolism of other important radio-elements such as cerium, ruthenium, cobalt and zinc. In the nutritional field, the analysis of the food surveys conducted in previous years was completed. The consumption-versus-age curves were plotted. The problems presented by food distribution channels were the subject of thorough-going statistical studies. Investigation of contamination transfers from the contaminated medium to food products, starting from the atmosphere, from the soil and from plants, was continued. Water pollution was the subject of searching investigations aimed at determining the behavior of certain radioelements about which little is at present known and which enter the aquatic food chains. Mathematical processing of the results obtained enabled an attempt to be made at calculating the levels of contamination by ^{90}Sr and ^{137}Cs, according to the general method of approach which had previously been developed. (auth)

48031 EXPOSURE TO RADIATION. Williams, Veronica (Ministry of Health and Medical Research Council Radiological Protection Service, Sutton, Eng.). Brit. Med. J., 2: 821 (June 28, 1969).

Some comments are made on a recent report (ibid., 2: 305 (May 3, 1969)) on a Ra vita emanator and an estimation of the radiation hazard due to the long-term ingestion of Rn solutions and the possible ingestion of Ra salts leached from the apparatus. Although the apparatus may provide unnecessary exposure to radiation, the report considerably overstates the hazard associated with leaching Ra from the apparatus. The total amount of Ra leached from the source at, presumably, a constant rate over the period of at least 20 yr since the apparatus had been used is compared with the maximum permissible body burden for Ra. It thus appeared that over 3 μCi had become detached from the main source and might have been ingested had the apparatus remained in use. This is stated as 50 times the permissible body-burden of Ra. The value for the maximum permissible body burden Ra is 0.1, not 0.06 μCi used by the writers. More important however, this value refers to the maximum permissible burden of Ra fixed in the skeleton, assuming a lifetime exposure of 50 yr to this burden. When Ra is ingested, only a fraction of the amount taken in is absorbed into the blood, and only a fraction of this is ultimately fixed in the skeleton. The actual amount of Ra which might have been ingested had the emanator remained in continual use would have been from 2 to 0.2 times the maximum permissible amount in drinking-water for radiation workers. (BBB)

48032 TOTAL RESPIRATORY DEPOSITION OF RADON DAUGHTERS FROM INHALATION OF URANIUM MINE ATMOSPHERES. Holleman, Dan F.; Martz, Dowell E.; Schiager, Keith J. (Colorado State Univ., Fort Collins). Contract AT(11-1)-1500. Health Phys., 17: 187-92(Aug. 1969).

Total deposition in the human respiratory tract of the short-lived radon progeny present in a typical uranium mine atmosphere was determined in thirty separate experiments. Effective diffusion coefficients for the total radon progeny activity were determined by diffusion tube sampling of the exposure atmosphere, and concentrations of RaA, RaB and RaC were measured in both the inspired and exhaled air. Respiration rates and tidal volumes were also measured for each experiment. Total percent Working Level depositions were in the range of 30 to 65%. Percent depositions for individual radon daughters were also measured, with mean values of 50.4%, 44.7% and 40.6% for RaA, RaB, and RaC, respectively, for an average respiration rate of 18 min^{-1} and an average tidal volume of 1.2 l. The experimentally determined relationships between total deposition and respiratory rate and tidal volume are given. (auth) (UK)

48033 BIOASSAY METHODS FOR ESTIMATING CURRENT EXPOSURES TO SHORT-LIVED RADON PROGENY. Gotchy, R. L.; Schiager, K. J. (Colorado State Univ., Fort Collins). Contract AT(11-1)-1500. Health Phys., 17: 199-218(Aug. 1969).

Concentrations of ^{210}Pb (RaD) and ^{210}Po (RaF) were measured in the urine, feces, blood, hair and whiskers from 25 people associated with the operation of a uranium mine near Golden, Colorado. The concentrations in blood, hair and whiskers were found to be correlated with occupational exposure by power function relationships. Blood levels of ^{210}Pb and ^{210}Po provided reasonable estimates of mean exposure levels in the range of 1 to 5 working levels (±50% or better) for samples pooled for one or more calendar quarters. ^{210}Pb or ^{210}Po activity in either hair or whiskers could be used to estimate mean exposure levels in the range of 0.4 to 7 working levels (±50% or better) when samples were pooled for one or more calendar quarters. A decreasing exponential relationship was found between the ^{210}Pb to ^{210}Po activity ratios in the blood of working uranium miners and years of underground experience. Possible applications of these relationships to exposure monitoring and some of the inherent problems associated with bioassays for uranium miners are discussed. (auth) (UK)

48034 ^{90}Sr IN HUMAN BONE (DENMARK 1964–1967). Levi, H.; Lindemann, J.; Fenger, K. (Univ. of Copenhagen). Health Phys., 17: 354-6(Aug. 1969).

Measurements of ^{90}Sr in human bone as reported earlier were continued. The results of the investigation are listed in tabular form. The results show that the ^{90}Sr content of bone of humans under 1 month old declined during the period January 1965 through October 1967 from values above 2 S. U. to below 1 S. U. The S. U. values of older children were still higher than those of fetuses and infants, and the scatter was larger, as observed earlier. (auth) (UK)

48035 DISTRIBUTION OF NATURALLY OCCURRING RADIONUCLIDES BELONGING TO THE URANIUM DECAY SERIES. 3. ^{210}Po, ^{226}Ra, AND URANIUM CONTENTS IN THE HUMAN URINE. Kuroda, Takeshi (Tokushima Univ., Japan). Igaku To Seibutsugaku, 75: 234-6(Dec. 10, 1967). (In Japanese).

Urine samples collected over 24 to 48 hour periods were wet-ashed with nitric acid, removing the nitric acid and dissolving the white residue in 0.5 N HCl. The ^{210}Po was separated from this solution and the remaining solution was divided for the analysis of ^{226}Ra and uranium. The recovery of ^{210}Po spikes averaged 94.4 ± 15.8%. Uranium was analyzed by reflectance fluorimetry of a solid cake on samples containing 0.1 to 1 μg uranium; many problems were encountered which contributed to poor reproducibility. The radionuclide assays of the urine from residents of the Miasa Village uranium mine area were consistently higher than those of Okayama City (Okayama University personnel); the workers actually handling the ore and products exhibited consistently higher values than the office workers in the same town. Although the number of samples was too small to allow a reliable statistical comparison, the trend of these differences is considered real. Data from other countries are listed for comparison. (TTT)

48036 ENVIRONMENTAL PROTECTION FOR NUCLEAR APPLICATIONS. Moeller, Dade W.; Goldin, Abraham S. (Harvard School of Public Health, Boston). J. Sanit. Eng. Div., Amer. Soc. Civil Eng., 95: 373-85(June 1969).

Current recombinations are summarized on environmental radiation protection, and some areas most urgently in need of further research are outlined. Among these areas are the improvement and simplification of surveillance and assessment technique (especially for such nuclides as ^{85}Kr and tritium), development of methods for the identification of radionuclides released from specific installations or through specific applications, formulation of standards for waste control, preparation of guides or standards for use in the planning and execution of operations involving major radionuclide releases, and the development of environmental countermeasures in the event of significant or unforseen releases. For a 1,000,000 Kw electrical reactor operating for one yr, the activities after the spent fuel has been stored for 100 days are tabulated. The cumulative amount of a few fission products from the entire nuclear industry in the future is also estimated. Of the products generated in nuclear fission, three are discharged to the environment in whole or in part, and are therefore of particular significance in terms of environmental protection. These include ^{131}I, ^{85}Kr, and tritium. Barriers available to the environmental engineer for preventing the release of radioactive materials from a reactor installation are cited. Reactor containment design is reviewed, as are cleanup procedures to be used after an accident. Clean-up techniques, in use or under development, include water sprays, air filtration and recirculation, and foam encapsulation. Environmental surveillance under normal and accident conditions is discussed. (BBB)

48037 FALLOUT CONCENTRATIONS IN CATTLE GRAZING HIGHLY CONTAMINATED RANGE. Blincoe, Clifton; Bohman, V. R. (Univ. of Nevada, Reno). Health Phys., 17: 559-64(Oct. 1969).

In 1958 a herd of beef cattle was moved to graze the desert range over which atmospheric nuclear weapons tests had just concluded. In 1962 the same herd of beef cattle was exposed to a contaminated range following an underground detonation (Bandicoot) about three months after grazing range contaminated by the Sedan cratering nuclear detonation. The observed data are qualitatively consistent with the known contamination of the test herd grazing range on the Nevada Test Site, and the physical half-life and metabolic rate constants of the radionuclides studied. Thyroid ^{131}I rose to very high concentrations when cattle grazed freshly contaminated range and then dropped very promptly. The degree of contamination with radioiodine was such that ^{131}I was easily measurable in soft tissues. The thyroid ^{131}I concentrations were about 1000 times that of soft tissues, with the blood concentration greater than in liver and muscle. Cesium-137 concentrations started from a higher pre-exposure level due to its long half-life, increased in response to grazing contaminated range and decreased when cattle were returned to normal ranges. Strontium-90 tissue concentrations increased when cattle grazed contaminated range and then decreased slowly. The observed concentrations of radioiodine in the thyroid glands indicated approximately the same degree of contamination with radioiodine by the two experiments. Much greater increases in radiostrontium and radiocesium concentrations occurred following the 1962 experiment. This is interpreted to indicate greater uptake of these long-lived isotopes resulting primarily from the Sedan cratering experiment than from the accidental release of fission products from the Bandicoot experiment. In each experiment the cattle received an estimated 80 rad to the thyroid gland. (auth) (UK)

48038 MEASUREMENT OF TRITIUM CONCENTRATION IN EXHALED WATER VAPOUR AS A MEANS OF ESTIMATING

BODY BURDENS. Chiswell, W. D.; Dancer, G. H. C. (United Kingdom Atomic Energy Authority, Amersham, Eng.). Health Phys., 17: 331-4(Aug. 1969).

A method for the estimation of tritium body burdens from the tritium concentration in exhaled water vapor is described. It is suggested that it may be a less objectionable procedure than urine sampling for factory personnel. (auth) (UK)

48039 BETA RADIOACTIVITY OF TOBACCOS MANUFACTURED IN RODOPI TOBACCO FACTORY OF PLOVDIV. Atmadzov, P.; Genkov, D. (Pavlov Higher Medical Inst., Plovdiv, Bulgaria). Folia Med. (Plovdiv), 10: 115-18(1968).

The results derived from measurements on radioactivity in Cl g of 15 brands of tobacco and tobacco of seven kinds of cigarettes manufactured in Rodopi Tobacco Factory of Plovdiv are reported. Measurements on β radioactivity of ashes and tobacco smoke obtained from burning a corresponding brand of tobacco are also given. The estimations show that in smoking there is no danger of β radioactive isotopes contained in tobacco smoke. (auth)

48040 DISTRIBUTION OF NATURALLY OCCURRING RADIONUCLIDES BELONGING TO THE URANIUM DECAY SERIES. 4. ^{226}Ra CONTENT OF FOOD. Kuroda, Takeshi (Tokushima Univ., Japan). Igaku To Seibutsugaku, 76: 31-3(Jan. 10, 1968). (In Japanese).

Previous studies showed that the contents of naturally occurring radionuclides in teeth and urine varies with the residence of the subjects. The ^{226}Ra content of foods produced in two different areas was compared to see whether there are also significant differences in this respect. Foodstuffs such as rice, sweet potato, cucumber, eggplant, and eggs bought directly from the producer, milk from the markets and prepared were examined. Food from the Miasa Hot Springs Laboratory of Okayama University and the Okayama University Hospital at Okayama City was analyzed. The samples were frozen and wet-ashed at 650°C. About 3 to 5 g of the ash were subjected to repeated nitric acid dissolutions, and the combined filtrates from the extractions were used for the analysis. Generally speaking, the analytical results confirmed what was previously expected. The ^{226}Ra content of eggs was much higher than that of other foods. This was followed by sweet potato, peas, and cucumber. The rather limited data reported from abroad were examined for comparison. (TTT)

48041 DISTRIBUTION AND TRANSFER MECHANISM OF THE RADIOACTIVE MATERIALS IN THE SNOW LAYERS. Kobayashi, Ugoro (Niigata Univ., Nagaoka, Japan). Niigata Daigaku Kogakubu Kenkyu Hokoku, No. 18, 1-14(Mar. 1969).

During the period February 1955 to April 1968, samples of the fallen snow were taken in a certain way at twenty-three spots in seven locations, and radioactivities of them were measured to reveal the state of vertical distribution of radioactive materials in the snow strata. On the basis of the analysis of the data thus obtained, mechanism of the concentration of radioactive materials in the uppermost part of the snow coverage, modes of transfer of radioactive (water soluble or insoluble) materials in the fallen snow, and causes contributing to the making of radioactive peaks which appear above frozen lines in the middle layers and at the bottom layer, were explained. (NSA of Japan)

Dosimetry and Monitoring

Refer also to abstracts 47651, 47774, 47775, 47784, 47844, 47846, 47855, 47861, 47908, 48033, 48224, and 48958.

48042 (HASL-214) FALLOUT PROGRAM QUARTERLY SUMMARY REPORT, JUNE 1, 1969-SEPTEMBER 1, 1969. Hardy, Edward P. Jr.; Rivera, Joseph (New York Operations Office (AEC), N. Y. Health and Safety Lab.). Oct. 1, 1969. 160p. Dep. CFSTI.

Current data from the HASL Fallout Program, The EURATOM Joint Nuclear Research Center at Ispra, Italy, The Radiological Physics Division at Argonne National Laboratory, and the Environmental Science Services Administration are presented. The initial section consists of interpretive reports and notes covering the following topics: Comments on fallout correlations made by Dr. E. Sternglass, estimating global deposition from surface air radioactivity, ^{90}Sr to calcium ratios in the diet from 1954 to 1959, and predictions of deposition and surface air radioactivity using a stratospheric model. Subsequent sections include tabulations of radionuclide levels in surface air, fallout, milk, other diet components, and tap water. A bibliography of recent publications related to radionuclide studies is also presented. (auth)

48043 (HASL-214(App.)) FALLOUT PROGRAM QUARTERLY SUMMARY REPORT, JUNE 1, 1969-SEPTEMBER 1, 1969. (New York Operations Office (AEC), N. Y. Health and Safety Lab.). Oct. 1, 1969. 392p. Dep. CFSTI.

Data are presented on the following surveillance studies bringing the data up to date through August 1969: ^{90}Sr and ^{89}Sr content in monthly deposition samples at world land sites from 1957 through April 1969; ^{90}Sr deposition and ^{90}Sr/^{89}Sr ratios at Atlantic Ocean weather stations from July 1963 to April 1969; ^{238}Pu, ^{239}Pu, and ^{240}Pu deposition at selected world land sites during June 1965 through January 1969; gross γ radioactivity in surface air samples from selected worldwide sites during January 1963 through May 1969; Radionuclides in surface air samples from selected worldwide sites during January 1963 through May 1969; ^{90}Sr/Ca ratios in milk in New York during April 1954 through March 1969; ^{90}Sr content of New York City tap water during August 1954 through May 1969; and the ^{137}Cs to ^{90}Sr ratio in New York City tap water during January 1965 through May 1969. All data are presented in tabular or graphic form. A table of conversion factors and a table of radionuclides are also given. (E.R.B.)

48044 (NSJ-tr-154) TENTATIVE APPROACH FROM THE INFORMATION THEORY TO THE PROBLEM OF INTERNAL CONTAMINATION. Anzai, Ikuro; Yoshizawa, Yasuo. Translated from Hoken Butsuri, 3: No. 2, 295-303(1968). 17p. Dep. CFSTI (U. S. Sales Only).

The measured values in the field of radiological protection are inevitably concerned with the uncertain factors that can never be resolved by mere improvement of measurement techniques. A concept of entropy popularly used in information theory was introduced in order to give quantitative estimation of the uncertainity that appears in the problem of internal contamination measurement. Body retention of the radioactive contaminant after a single intake changes with time according to the physical decay and biological elimination. Hence there is uncertainty in estimating the initial amount of contamination from a single value of one-point sampling and measurement. When the detected body burden is q(μCl), the probability that the initial intake Q_0(μCl) was over the pre-decided reference value q_0(μCl) was given as follows, $p(Q_0 \geq q_0) = 1 - (T_{eff}/\tau) \log_2 (q_0/q)$ where τ is the interval of measurement and T_{eff} is the effective half life. Apparently, $p(Q_0 < q_0) = (T_{eff}/\tau) \log_2 (q_0/q)$. A graphical presentation of entropy is given and the effectiveness of the internal contamination sampling program is discussed. (auth)

48045 (NYO-2740-6) ANNUAL REPORT ON RESEARCH PROJECT [RADIATION PHYSICS, BIOPHYSICS, AND RADIATION BIOLOGY], JANUARY 1, 1969. (Columbia Univ., New York. Radiological Research Lab.). Contract AT(30-1)-2740. 379p. Dep. CFSTI.

Separate abstracts were prepared on the 21 full reports on research activities. The reports are divided into sections including; dosimetry, measurements of microscopic distribution of radiation energy, radiation protection, ancillary problems, biophysics, and radiobiology. A bibliography is included at the end of the report. (E.R.B.)

For abstracts of individual sections see: 47734-47738, 47846-47848, 48012-48014, 48046-48049, 48198-48200, 48261, 48262, and 49236.

48046 (NYO-2740-6, pp 32-95) DOSIMETRY STUDIES FOR A FAST NEUTRON THERAPY BEAM. Goodman, L. J.; Koch, U. (Columbia Univ., New York. Radiological Research Lab.).

The suitability of various fast neutron sources for use in cancer therapy was examined by investigation of depth dose and skin sparing effects at four neutron facilities. The instrumentation and apparatus used for this investigation are briefly described. A comparison of the data from the various facilities is also included. (B.G.D.)

48047 (NYO-2740-6, pp 99-106) DOSIMETRY OF MONOENERGETIC NEUTRONS. CALCULATION OF PARAMETERS OF DOSIMETRIC SIGNIFICANCE IN MONOENERGETIC NEUTRON IRRADIATIONS. Bengtsson, L. G.; Goodman, L. J.; Robertson, J. S. (Columbia Univ., New York. Radiological Research Lab.).

Inflorescences of Tradescantia sp. were irradiated with monoenergetic neutrons (0.43 MeV ± 11%) and the dose and dose rate to the inflorescences determined. The neutron dose rates were measured using a 6 mm diameter, spherical, gas flow, tissue equivalent gas multiplication chamber utilizing a potential of 3050 V. The dose rate measurements were then correlated to the current, the measurements serving to calibrate the monitor chamber that was subsequently used to determine the dose. (E.R.B.)

48048 (NYO-2740-6, pp 96-8) DOSIMETRY OF MONOENERGETIC NEUTRONS FOR TRADESCANTIA. Goodman, L. J.; Koch, U. (Columbia Univ., New York. Radiological Research Lab.).

The magnitude of the neutron energy and dose rate and the

attainable homogeneity of neutron energy and dose in the irradiated specimen are determined by a large variety of parameters. A computer program called ANY (Accelerator Neutron Yield) was developed to facilitate the procedure of determining these parameters. When the various parameters are supplied, the program gives the relevant neutron energy and the limits of variation of this energy within the solid angle subtended by the object. Several subprograms were developed including KINPRAM, ELOS, MANY, ATTY, and SD-TIME to provide quantitative data for the parameters used in ANY. (E.R.B.)

48049 (NYO-2740-6, pp 131-5) MEASUREMENT OF ^{60}Co SPECTRA. Dicello, J. F.; Srdoc, D. (Columbia Univ., New York. Radiological Research Lab.).

The distributions of the energy deposited by the secondary electrons attributable to cobalt-60 gamma radiation interactions with tissue-equivalent spheres of 0.25, 0.5, 1.0, and 2.0 μ diameters are presented. These spectra were measured with a 1-inch proportional counter and a ¼-inch proportional counter. (W.H.K.)

48050 (ORNL-tr-2201) CALCULATION OF THE RADIATION DOSE IN THE INTERIOR OF A SATELLITE WITH CONSIDERATION OF THE STRUCTURE OF THE SATELLITE AND THE ANGULAR DISTRIBUTION OF THE RADIATION. Wohlleben, K.; Baeuerlein, R.; Riekert, H. (Bundesministerium fuer Wissenschaftliche Forschung, Bad Godesberg (West Germany)). Translated for Oak Ridge National Lab., Tenn., from report BMwF-FB-W-69-03. 29p. Dep. CFSTI.

A method is described for calculating the radiation dose rate inside a defined satellite structure when the dose rate is a known function of the radiation-shield thickness. The possibilities of isotropic and anisotropic radiation are covered. The ALGOL program SATSTRUKTUR, based on this method, is described. This program can be used for calculating the radiation dose rate for symmetric-axis satellite structures of random configuration and rotation-symmetric pitch angle distribution. Results of the dose-rate calculations for the AZUR satellite are given. (auth)

48051 (STI/PUB-199) RADIATION PROTECTION MONITORING. Proceedings Series. Proceedings of a Regional Seminar for Asia and the Far East held in Bombay, 9-13 December 1968. (International Atomic Energy Agency, Vienna (Austria)). 1969. 567p. (CONF-681203). IAEA: $13.00; Austrian Schillings 336,-; £ 5.8.4; F.Fr. 63,70; DM 52,-.

Separate abstracts were prepared for 46 of the 47 papers presented. The remaining paper was previously abstracted in NSA as 23: 9694. (W.H.K.)

For abstracts of individual papers see: 47770-47782, 47855-47865, 47908, 48057-48072, 48074, 48075, 48078, 48079, and 49313.

48052 IONIZING RADIATION: BENEFITS VERSUS RISKS. Morgan, Karl Z. (Oak Ridge National Lab., Tenn.). Health Phys., 17: 539-45(Oct. 1969).

Over 90% of the genetic dose to the United States population from man-made sources of ionizing radiation derives from medical exposure. Most of this is from diagnosis and only about 1% is from occupational exposure. It is estimated that over 90% of the health physicists in the United States are engaged in programs designed to reduce unnecessary occupational exposure and most of these efforts are limited to the nuclear energy industry which, partly through their efforts, has become one of the safest of all modern industries. There is no question that medical x-ray is an essential diagnostic tool; however, this in no wise justifies an average patient dose that may be 10 times that necessary to obtain required medical information. It is indicated that through education, training, certification and proper motivation of all doctors and x-ray technicians permitted to use x-ray diagnosis, by the application of improved techniques and the use of better equipment, patient dose can be reduced by an order of magnitude while greatly increasing the amount and improving the quality of diagnostic information. Although many lives are saved by medical x-ray diagnosis, on the assumption of a linear relationship between dose and effect considerable lives also are lost because of unnecessary and excessive patient exposure. It is expected that in the days ahead a large fraction of the attention of the health physics profession will be directed toward maximizing the ratio of benefits to risks in medical x-ray diagnosis. (auth) (UK)

48053 FORMULA FOR THE EFFECT ON ROENTGEN RAY DEPTH DOSE OF A CHANGE IN FOCAL DISTANCE. Jackson, W. (Western Regional Hospital Board, Glasgow). Acta Radiol., Ther., Phys., Biol., 8: 279-93(Aug. 1969).

The manner in which x ray depth dose depends on focal distance is described in terms of a formula involving the parameter that represents the variation of scatter radiation with focal distance. Practical applications of the formula are given and some consequences of its application to published data discussed. (auth)

48054 ENVIRONMENTAL RADIATION STUDIES AND PRECAUTIONARY MEASURES ON THE HIGH ALTITUDE COSMIC RAYS, FISSION PRODUCTS FROM NUCLEAR DETONATION, AND AIRCRAFT EQUIPMENT. 3. EXTERNAL RADIATION EXPOSURE OF PILOTS FROM HIGH ALTITUDE COSMIC RAYS AND AIRCRAFT DIALS USING SELF LUMINOUS RADIOACTIVE PAINTS. Naba, Katsumi (Keio Univ., Tokyo). Keio Igaku, 46: 33-45(Jan. 1969). (In Japanese).

Studies concerning the biological effects of cosmic rays on jet pilots were carried out using nuclear emulsion chamber. The latitude effects and biological evaluation were investigated, comparing N 34° of Central Japan with the polar flight from Tokyo through the North Pole to Amsterdam at an altitude of 30,000 to 40,000 ft. The results showing the number of protons, ionized particles, and star production rate are as follows: For N 34°, 5.6×10^{-4} proton/cm^2/sec, 3.7×10^{-3} ionized particle/cm^2/sec, 335 ± 25 disintegration/cc/day in emulsion. For the polar flight 438 ± 42 disintegration/cc/day in emulsion. The conversion factor of star production rate in emulsion to human tissue was estimated as 1.88, comparing the total cross section of both emulsion and tissue. From these data, the Rem evaluation of cosmic ray exposure for jet pilot is as follows: For N 34° at 30,000 ft 370 mRem to 435 mRem/960 hrs per year, at 40,000 ft 670 mRem to 735 mRem/960 hrs per year. For the polar flight at 30,000 ft 390 mRem to 475 mRem/960 hrs per year, at 40,000 ft 690 mRem to 780 mRem/960 hrs per year. If SST pilots of a polar flight were exposed over 10 Rem/hr in giant solar flares, then they should instantaneously descend from altitude 60,000 to 80,000 ft to under 35,000 ft. There should be warning by airborne radiation monitor alarmed at 50 mRem/hr or over, and early warning of flare burst occurrence by continuously observing solar change of microwave radiation on the ground. Other sources of external radiation are from aircraft dials and safety devices using ^{221}Ra self-luminous paints. The integrated dose at the pilot's seat is 192 mRem/960 hrs per year. (auth) (TSS)

48055 PERSONNEL MONITORING BY PAEC FILM BADGE SERVICE. Mirza, Khalid Farooq; Malik, Walayat Khan (Atomic Energy Centre, Lahore). Nucleus (Lahore), 5: 59-64(July-Dec. 1968).

The results of film badge dose measurements for 66 Pakistan organizations from 1960 through 1967 are tabulated. (W.H.K.)

48056 INTERSTITIAL IRRADIATION OF THE PITUITARY GLAND WITH A ^{90}Sr-^{90}Y APPLICATOR HAVING ADJUSTABLE ACTIVE LENGTH. Baerring, N. E.; Holmer, A.; Notter, G.; Ruden, B. I. (Aktiebolaget Atomenergi, Studsvik, Sweden. Regionsjukhuset, Oerebro, Sweden. Inst. of Radiophysics, Stockholm). Acta Radiol., Ther., Phys., Biol., 8: 294-300(Aug. 1969).

A ^{90}Sr applicator for interstitial irradiation of the pituitary gland is described. The radiation source consisted of 300 mCi ^{90}Sr as strontium sulphate hermetically sealed into the end of a stainless steel needle. Measurements of the dose distribution around the ^{90}Sr-^{90}Y source were made by thermoluminescent dosimetry with lithium fluoride phosphors. (auth)

48057 NEUTRON DOSE DISTRIBUTIONS IN AN INFINITE SLAB OF STANDARD MAN COMPOSITION. MAXIMUM PERMISSIBLE FLUXES OF NEUTRONS. Nagarajan, P. S. (Bhabha Atomic Research Centre, Trombay, India). pp 61-78 of Radiation Protection Monitoring. Vienna, International Atomic Energy Agency, 1969.

From Regional Seminar for Asia and Far East on Radiation Protection Monitoring, Bombay, India. See STI/PUB-199; CONF-681203.

Monte-Carlo estimates of depth-dose distributions in an infinite slab phantom of standard man composition have been obtained for normal, angular and isotropic incidence of neutrons of energies ranging from thermal to 10 MeV. The results for normal incidence of neutrons are compared with those available in the literature and the agreement is found to be good within ±10%. This study confirms the existing maximum permissible fluxes except in the intermediate-energy range. In this range higher maximum permissible fluxes are recommended. (auth)

48058 DOSE CONVERSION FACTORS FOR Am-Be, Pu-Be, Po-Be, AND Am-B NEUTRON SOURCES. Mehta, S. K. (Bhabha Atomic Research Center, Trombay, India); Burrus, W. R. pp 115-22 of Radiation Protection Monitoring. Vienna, International Atomic Energy Agency, 1969.

From Regional Seminar for Asia and Far East on Radiation Protection Monitoring, Bombay, India. See STI/PUB-199; CONF-681203.

The dose conversion factors, i.e., the first collision dose (kerma) (K), the first collision RBE dose (kerma equivalent) (Keq),

and the RBE dose (dose-equivalent) (DE), per unit flux for the Am–Be, Pu–Be, Po–Be and Am–B neutron sources have been measured with the modified Bonner sphere neutron spectrometer. The spectrometer covered the energy range 0.01 eV–15 MeV. The method used to analyze the data took into account the known smoothness of the spectrum from (α,n) sources and assumed an upper bound for the neutron flux above 5.5 MeV known from previous measurements. The values of DE per unit flux for the four sources were found to be $(3.79 \pm 0.23) \times 10^{-8}$, $(3.72 \pm 0.28) \times 10^{-8}$, $(3.84 \pm 0.19) \times 10^{-8}$ and $(3.75 \pm 0.21) \times 10^{-8}$ rem/n cm^2, respectively. (auth)

48059 RADIATION PROTECTION AND MONITORING SERVICES AT THE BANDUNG REACTOR CENTRE. Tamat, S. B.; Wirjosimin, S.; Markham, W.; Rukmantara, R. M.; Supadi, S. (Bandung Reactor Center, Indonesia). pp 149-57 of Radiation Protection Monitoring. Vienna, International Atomic Energy Agency, 1969.

From Regional Seminar for Asia and Far East on Radiation Protection Monitoring, Bombay, India. See STI/PUB-199; CONF-681203.

A description is given of the radiation protection service at the Bandung Reactor Center, including such activities as monitoring the radiation from the TRIGA MARK II (250-kW) reactor which is measured in the reactor hall and on the reactor deck. Another area surveyed by the protection service is the Radioisotope Laboratory. Also discussed are problems concerning instrument failure and the availability of man power. To meet the safety requirements, the protection service is attempting to manufacture its own instruments. (auth)

48060 RADIATION PROTECTION MONITORING ASSOCIATED WITH PLUTONIUM FUEL FABRICATION IN JAPAN. Kinoshita, M.; Maruyama, M. (Power Reactor and Nuclear Fuel Development Corp., Ibaragi, Japan). pp 159-70 of Radiation Protection Monitoring. Vienna, International Atomic Energy Agency, 1969.

From Regional Seminar for Asia and Far East on Radiation Protection Monitoring, Bombay, India. See STI/PUB-199; CONF-681203.

The Plutonium Fuel Development Laboratory at Tokai, Japan, commenced operation in January 1966. Since then, more than 6.5 kg of PuO_2 have been processed. Full-size fuel pins and various irradiation samples containing UO_2–PuO_2 have been fabricated in the laboratory, and physical and chemical evaluation of the fuel material has also been performed. Health physics problems encountered in routine radiological monitoring in the laboratory are described. These problems are caused by various contamination conditions, and several techniques are used for monitoring. The sniffer system combined with the nasal smear, routine surveying on gloves by the glove-box operators and the monitoring of shoes and shoe covers at the zone entrances have been found to be effective. The levels of surface and air contamination in the laboratory have been low, but any deviation from the normal activity level must be noted to ensure continuously good working conditions. (auth)

48061 NATURE OF AEROSOLS IN NUCLEAR OPERATIONS. Vohra, K. G. (Bhabha Atomic Research Centre, Trombay, India). pp 171-82 of Radiation Protection Monitoring. Vienna, International Atomic Energy Agency, 1969.

From Regional Seminar for Asia and Far East on Radiation Protection Monitoring, Bombay, India. See STI/PUB-199; CONF-681203.

In the monitoring of airborne radioactivity it is necessary to have a detailed knowledge of the nature of the aerosols involved, for example particle size distribution, chemical nature, charge, radioactivity, structure and state of aggregation. Aerosol formation processes in nuclear operations are described, and the characterization of aerosols in general and the nature of aerosols encountered in different nuclear operations are discussed. Studies carried out on aerosols formed from the gas phase, the role of condensation nuclei in the formation of radioactive aerosols, and the plutonium aerosols are described. (auth)

48062 SIMPLE METHOD FOR PROMPT ESTIMATION OF THE AMOUNT OF PLUTONIUM IN AIR. Bhanti, D. P.; Soman, S. D. (Bhabha Atomic Research Centre, Trombay, India). pp 183-98 of Radiation Protection Monitoring. Vienna, International Atomic Energy Agency, 1969.

From Regional Seminar for Asia and Far East on Radiation Protection Monitoring, Bombay, India. See STI/PUB-199; CONF-681203.

The use of absorption techniques for evaluating the plutonium contribution to the activity collected on a filter-paper air sample by using the energy difference between alpha particles of plutonium and natural atmospheric alpha activity is described. Conventional methods mainly use the particle size difference or alpha spectroscopy for this purpose. Aluminized mylar film is found suitable as an absorber for the identification of plutonium in the presence of natural alpha emitters in the atmosphere. Plutonium activity collected on a filter paper can thus be estimated within 30 minutes, the process involving only two or three observations. Basic principles underlying the method, its limitations and the errors involved are discussed. (auth)

48063 EXPERIENCE IN RADIATION PROTECTION MONITORING. Saimongkol, U. (Office of Atomic Energy for Peace, Bangkok). pp 199-207 of Radiation Protection Monitoring. Vienna, International Atomic Energy Agency, 1969.

From Regional Seminar for Asia and Far East on Radiation Protection Monitoring, Bombay, India. See STI/PUB-199; CONF-681203.

Experience in radiation protection monitoring acquired in the Thai Office of Atomic Energy for Peace is described. The subjects discussed are the film badge service, reactor monitoring, survey meters and neutron monitors. (auth)

48064 RADIATION MONITORING. PURPOSE, ACCURACY REQUIRED AND INTERPRETATION OF RESULTS. Hayodom, V. (Office of Atomic Energy for Peace, Bangkok). pp 209-15 of Radiation Protection Monitoring. Vienna, International Atomic Energy Agency, 1969.

From Regional Seminar for Asia and Far East on Radiation Protection Monitoring, Bombay, India. See STI/PUB-199; CONF-681203.

Twenty percent error is considered satisfactory in monitoring work, and a larger error is acceptable when the radiation level is of the order of 10% of the maximum permissible level. Problems of neutron and surface contamination monitoring are reviewed and different views on pre-operational off-site surveys are compared. The order in which milk, beef, and vegetables become unfit for human consumption is listed. It is pointed out that ^{90}Sr anslysis may not be required for airborne release. (auth)

48065 ESTIMATION OF THE CONCENTRATION OF RADON DISSOLVED IN URANIUM MINE WATERS. Raghavayya, M. (Bhabha Atomic Research Centre, Trombay, India). pp 227-35 of Radiation Protection Monitoring. Vienna, International Atomic Energy Agency, 1969.

From Regional Seminar for Asia and Far East on Radiation Protection Monitoring, Bombay, India. See STI/PUB-199; CONF-681203.

Radon of mine water origin is very often the main source of air contamination in uranium mines, especially in barren portions. Quantitative estimation of the gas in mine waters therefore forms one of the most important branches of radiological survey in uranium mines. For purposes of estimation, radon is removed from the water sample by bubbling radon-free air through it. Experiments have shown that the quantity of radon from the water sample is an exponential function of the volume of air bubbled. A method of quantitative estimation of radon dissolved in water has been developed on this basis. Radon-free air is bubbled through the water sample contained in a radon bubbler in equi-volume steps and the activity of the gas removed in each step is separately determined. The total radon content of the sample is expressed as the sum of the activities of the gas removed in the first "i" steps plus a correction factor (for the residual radon) involving the activities removed in the next two steps. Results of a few estimations done in one of the Indian uranium mines are tabulated. (auth)

48066 STUDY OF FILTER MEDIA FOR AIR-SAMPLING PURPOSES. Sukumaran, K. V. (Bhabha Atomic Research Centre, Trombay, India). pp 243-51 of Radiation Protection Monitoring. Vienna, International Atomic Energy Agency, 1969.

From Regional Seminar for Asia and Far East on Radiation Protection Monitoring, Bombay, India. See STI/PUB-199; CONF-681203.

A comparative study of six filter media commonly used in monitoring airborne radioactivity has been carried out. The following characteristics were studied: (1) filtration efficiency for uranyl nitrate aerosol and natural activity, (2) pressure drop at various flow rates, (3) absorption factor for alpha particles, (4) use for alpha pulse-height analysis, and (5) physical properties such as tensile strength, thickness, density and ash content. From the results obtained, the order of preference for use in routine monitoring is found to be CWS-6, HV-70, AGF/F, AGF/A, Whatman-41 and Whatman-42. (auth)

48067 MONITORING OF THE WORKING ENVIRONMENT IN A FUEL REPROCESSING PLANT. Krishnamony, S.; Dua, S. K.; Bhanti, D. P.; Sundararajan, A. R. (Bhabha Atomic Research Centre, Trombay, India). pp 253-67 of Radiation Protection Monitoring. Vienna, International Atomic Energy Agency, 1969.

From Regional Seminar for Asia and Far East on Radiation

Protection Monitoring, Bombay, India. See STI/PUB-199; CONF-681203.

Procedures and techniques used for the monitoring of radiation hazards at the Trombay Fuel Reprocessing Plant are discussed. A detailed description is given of the centralized gamma- and air-monitoring system together with methods of testing and calibration with particular reference to criticality monitors. A critical evaluation of the system's performance in the light of the experience gained during the last three years is presented. Practical methods for the quick estimation of beta exposures by means of conventional survey instruments and pocket dosimeters are reported. Evaluation and interpretation of air-sampling data obtained through different types of air-sampling instruments are discussed. (auth)

48068 MONITORING OF THE WORKING ENVIRONMENT. PURPOSE, ACCURACY REQUIRED, AND INTERPRETATION OF RESULTS. Ishihara, T. (Japan Atomic Energy Research Inst., Tokyo); Yoshida, Y. pp 269-83 of Radiation Protection Monitoring. Vienna, International Atomic Energy Agency, 1969.

From Regional Seminar for Asia and Far East on Radiation Protection Monitoring, Bombay, India. See STI/PUB-199; CONF-681203.

Two kinds of radiation control methods are considered: the monitoring of personnel who might be exposed to radiation; and the monitoring of the environment. Monitoring the environment includes: (1) ascertaining that the levels of radiation and contamination in the working area and the environment are within certain limits, (2) estimation of the dose to the working personnel as well as to the general public, and (3) establishment of a system for undertaking appropriate measures in case of emergency. The basic recommendations of the ICRP refer to organ and tissue doses which cannot be measured directly by routine monitoring. Radiation surveys, the monitoring of surfaces, hands, shoes and clothes, and air monitoring do not provide any particular organ dose. Monitoring is a relatively easy method, but it should be kept in mind that the results may differ depending on interpretation. Derived limits should be on the basis of the ICRP recommendations, and the records of monitoring should be compared with the limit. According to circumstances, the working environment may be monitored by the installed instruments and by portable survey meters. For monitoring instruments, preference should be given to reliability rather than accuracy. Energy dependence and directional effect cannot be avoided, and in some cases readings on the instruments are not linearly proportional to a simple physical parameter. The adequacy of the interpretation of the readings is therefore limited by the assumptions made. From the viewpoint of monitoring, high accuracy is not required in the range well below the maximum permissible dose (MPD) to attain the basic objectives of radiation protection. From the legal aspect, higher accuracy is required in the vicinity of the MPD. The monitoring of the working environment is described. (auth)

48069 MEDICAL INTERPRETATION OF RESULTS OBTAINED WITH A FILM BADGE SERVICE. Meilland, G. (International Atomic Energy Agency, Vienna). pp 371-2 of Radiation Protection Monitoring. Vienna, International Atomic Energy Agency, 1969.

From Regional Seminar for Asia and Far East on Radiation Protection Monitoring, Bombay, India. See STI/PUB-199; CONF-681203.

In spite of recent improvements, the film badge gives only very rough indications of the whole-body total exposure. It remains, however, a satisfactory method of monitoring, particularly for the occupational type of exposure, as it monitors the actual place of work. Its use for research is limited, but wearing the badge has a psychological value. (auth)

48070 DEVELOPMENT OF A NATIONAL FILM BADGE MONITORING SERVICE. Yeabsley, H. J. (National Radiation Lab., Christchurch, N. Z.). pp 425-36 of Radiation Protection Monitoring. Vienna, International Atomic Energy Agency, 1969.

From Regional Seminar for Asia and Far East on Radiation Protection Monitoring, Bombay, India. See STI/PUB-199; CONF-681203.

The evolution of the New Zealand Radiation Monitoring Film Service and the results obtained are discussed. The experiences encountered in the operation of the service in the last 18 years are used to illustrate the administrative and technical problems which arise in individual radiation monitoring. (auth)

48071 RADIATION PROTECTION SERVICE IN CEYLON. Fernando, P. L. T. (Cancer Inst., Maharagama, Ceylon); Siriwardene, P. P. G. L.; Wikramanayake, T. W. pp 437-8 of Radiation Protection Monitoring. Vienna, International Atomic Energy Agency, 1969.

From Regional Seminar for Asia and Far East on Radiation Protection Monitoring, Bombay, India. See STI/PUB-199; CONF-681203.

The film badge service for monitoring at the x-ray and radioisotope diagnostic installations and therapeutic installations in Ceylon is briefly discussed. (W.H.K.)

48072 EXPERIENCE IN THE PHILIPPINES WITH RADIATION PROTECTION MONITORING. Bernardo, B. C. (Philippine Atomic Energy Commission, Manila). pp 439-46 of Radiation Protection Monitoring. Vienna, International Atomic Energy Agency, 1969.

From Regional Seminar for Asia and Far East on Radiation Protection Monitoring, Bombay, India. See STI/PUB-199; CONF-681203.

The various health physics operations, with emphasis on radiation protection monitoring, in the Philippines are described. The equipment used and procedures followed are briefly discussed. An attempt to present some problems regarding radiological protection is made and studies undertaken to minimize and correct for inherent and non-inherent sources of error in film badge measurements of personnel exposures are also presented. The aim of this report is to describe to other atomic research establishments Philippine experience with the different aspects of radiation protection monitoring, its problems and possible solutions for the attainment of a common goal. (auth)

Radiation Protection

Refer also to abstracts 47679, 47681, and 48079.

48073 WAYS OF IMPROVING RADIATION PROTECTION IN DENTAL RADIOGRAPHY. Kanishchev, P. A.; Ryabtsev, A. S. Sov. Med., 29: No. 12, 80-3(Dec. 1966). (In Russian).

While taking dental x-ray pictures both the patient and the medical staff become exposed to the effect of fairly high radiation doses. Especially harmful is irradiation of the patient's gonads. Methods of protection against radiation are outlined. A telescopic antidiffusion arrangment provided with a mechanical triangulator was designed. The device consists of an antidiffusion barrel, a telescopic tube, mechanical triangulator, holders with protective screens and an additional filter (an aluminum sheet 4 mm thick). Dosimetry under conditions involving the use of the proposed protective measures demonstrated the magnitude of irradiation to which the staff is then exposed to be 340 times lower than the permissible standard level. Under these circumstances the patient's radiation fields are greatly reduced, being restricted to an insignificant tissue area in the region of the teeth undergoing investigation. The gonads are excluded from the irradiation zone. (auth)

48074 PRINCIPLES OF RADIATION PROTECTION. Karamourtzounis, J. N. (World Health Organization, Geneva). pp 15-19 of Radiation Protection Monitoring. Vienna, International Atomic EnergyAgency, 1969.

From Regional Seminar for Asia and Far East on Radiation Protection Monitoring, Bombay, India. See STI/PUB-199; CONF-681203.

In the rapidly developing areas of occupational and public health devoted to the protection of people from both immediate and delayed harmful (and sometimes irreversible) effects of radiation exposure, industrial hygienists, radiological physicists, and radiologists must now assume the additional responsibility of protection against radiation. Everyone during his life will have one or more x rays taken for diagnostic purposes. The doses received, depending upon the site, are not harmful to the individual; from the genetic aspect, however, the increasing use of x ray examination does present a danger, since almost the whole population is involved. Rapid progress in the development of nuclear energy and the practical extension of its use in medicine, agriculture, and industry are steadily increasing the potential danger of large groups of the population being exposed to radiation, and radiation hazards are becoming an important aspect of industrial and public hygiene. World Health Organization (WHO) is concerned with the overall evaluation of population exposure from peaceful uses of atomic energy and through medical practice, the evaluation of radiation risks, and the control of medical radiation exposure. WHO stimulates and provides technical assistance for the development of appropriate programs of radiation protection with respect to the agricultural, industrial, and medical applications of radioisotopes, x rays, and radium. (auth)

48075 SECONDARY STANDARDS DERIVED FROM ICRP BASIC SAFETY STANDARDS. Ganguly, A. K.; Pillai, K. C. (Bhabha Atomic Research Center, Trombay, India). pp 27-41 of Radiation Protection Monitoring. Vienna, International Atomic Energy Agency, 1969.

From Regional Seminar for Asia and Far East on Radiation

Protection Monitoring, Bombay, India. See STI/PUB-199; CONF-681203.

The derivation of secondary standards from the basic recommendations of the ICRP is discussed. The secondary standards are evolved from maximum permissible doses to body organs, taking cognizance of the physical and physiological characteristics of the standard man. The premises for derivation of secondary standards on the basis of such factors as body and organ weights, air and water (and food) intake, intake of elements, tissue concentration of elements, and other biological parameters are examined for applicability to Indian conditions. Substituting some of the above factors applicable for Indians, the values of which are available, revised MPC_W values for a few radionuclides are obtained. It is emphasized that investigations on these lines should be encouraged so that norms applicable to man living in different regions of the world could be evolved. Limitations in using secondary standards, especially MPC_W, directly for occupational workers are discussed. The importance of investigating concentration factors for radionuclides in food items and their effects on MPC_W values are demonstrated. The implications of using the specific activity concept to prescribe acceptable discharge limits are discussed. Limitations of direct radiation monitoring in the environment and the usefulness of indicator organisms for environmental monitoring are indicated. (auth)

Safety Procedures

Refer also to abstracts 47716, 48033, 48035, 48074, 48075, and 48248.

48076 (NP-tr-1780) THE ROLE OF THE HAEMOGRAM IN ASSESSING FITNESS FOR RADIATION WORK: A SURVEY OF 1,673 SUBJECTS. Strambi, E. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Translated by C. R. Brightmore (Atomic Energy Research Establishment, Harwell, Eng.), from report RT/PROT-(68)12. 31p. Dep. CFSTI.

This paper was abstracted in NSA from the original language as 23: 8001. (H.L.W.)

48077 (TID-25085) CONTROL AND REDUCTION OF OIL MISTS FROM MECHANICAL VACUUM PUMPS. A GLOVEBOX FIRE SAFETY APPLICATION. Edwards, R. D.; Johnson, P. E.; Yao, C. (Factory Mutual Research Corp., Norwood, Mass.). 1969 29p. GPO $0.45.

Oil mists exhausted from mechanical vacuum pumps into glovebox exhaust systems can clog or violate high efficiency exhaust filters, and deposit oil film in duct-work that presents a fire hazard. A research project was undertaken to develop a means of mist control. The causes and characteristics of oil mist formation were examined. Three methods of resolving the problem were investigated: simple modification of existing pumps, substitution of silicone oils for conventional pump oils, and collection and removal of oil mists from pump exhaust lines. It was concluded that, within the scope of methods investigated, mist formation could not be prevented, and that some method of mist control would be needed. Several types of mist collectors were evaluated. Depending on the capacity of the pump and its application, a York demister, a Pall cartridge filter, or a high efficiency air filter, in the exhaust line of mechanical pumps, are recommended for collecting oil mists. Recommendations are also made on the arrangement of mist collectors for safe, efficient operation. (auth)

48078 BASIS OF THE ICRP MAXIMUM PERMISSIBLE DOSES AND APPLICATION OF BASIC SAFETY STANDARDS. Dunster, H. J. (United Kingdom Atomic Energy Authority, Harwell, Eng.). pp 3-13 of Radiation Protection Monitoring. Vienna, International Atomic EnergyAgency, 1969.

From Regional Seminar for Asia and Far East on Radiation Protection Monitoring, Bombay, India. See STI/PUB-199; CONF-681203.

Some of the effects on man of ionizing radiation have a long latent period (many years) and are severe, sometimes irreversible, by the time they can be detected. It is thus not sufficient to assess the adequacy of a radiation protection program by direct checks on the health of the exposed workers. A more effective criterion is needed and is provided reasonably well by radiation dose. Since there is some correlation between dose and injury it is possible, at least in principle, to define a maximum permissible dose by assessing an acceptable level of injury. In practice, the choice is complicated by uncertainties in the dose-effect relationship and by uncertainties in the meaning of words, such as "acceptable" and "permissible." Nevertheless, numerical values widely accepted were selected and recommended by the International Commission on Radiological Protection. Two aspects of the application of the maximum permissible doses are important in relation to monitoring. The limits must be used prospectively with a choice of operating procedures, so that the doses are held below the maximum permissible values, and they must be used retrospectively as a criterion against which to decide whether the operational procedures were satisfactory. The interpretation of monitoring results in terms of the basic maximum permissible doses should form an integral part of the design of monitoring programs, both for the prospective control of exposures and for their retrospective confirmation. (auth)

48079 RADIOBIOLOGICAL EFFECTS, ICRP RECOMMENDATIONS AND PUBLIC HEALTH. Meilland, G. (IAEA, Vienna). pp 21-5 of Radiation Protection Monitoring. Vienna, International Atomic Energy Agency, 1969.

From Regional Seminar for Asia and Far East on Radiation Protection Monitoring, Bombay, India. See STI/PUB-199; CONF-681203.

The effects of radiations are classified into three groups. Only the acute effects from high doses are obviously related to radiations, the others being demonstrated by epidemiological studies. The responsibility of public health authorities is emphasized and the relative risks of radiation exposure are evaluated. Although these risks are comparatively minor, it is necessary to keep exposure to radiation not only within an acceptable limit, but also at as low a level as possible. This is achieved by limiting the use of radiation to essential purposes only, by improving the sensitivity of instruments and, most of all, by improving training. (auth)

Civil Defense

Refer also to abstract 48081.

Legal Aspects

Refer also to abstracts 47729 and 47947.

48080 THE ENERGY POLICY: AIMS AND MEANS. Wickman, Krister (Industridepartementet, Stockholm). Tek. Tidskr., 99: 489-90(1969). (In Swedish).

A review is given of the Swedish government energy policy, its objectives and measures. Topics included are: The commercial breakthrough of nuclear power, uranium supply, the distribution of tasks between Asea-Atom and Aktiebolaget Atomenergi, the environmental aspects on power production and the role of a nation-wide planning. (Sweden)

48081 WORK OF A FIRST AID MEDICAL TEAM IN ELIMINATING THE CONSEQUENCES OF A NUCLEAR ATTACK. Zaleskii, M. D. Zdravookhr. Beloruss., No. 11, 54-8(1968). (In Russian).

The basic principles for the organization and work of a first aid medical team (OPM) as the main unit of the civil defense (GO) medical service (MS) in the first stage of medical support of evacuation are discussed. The basic tasks of the OPM are the following: reception and classification of the large flow of casualties; dosimetric surveillance and partial sanitary treatment of casualties, and also partial decontamination of their clothing and footwear; medical classification with respect to the nature and severity of injury and the evacuation schedule; temporary isolation of patients with infectious diseases and patients with mental disorders; emergency physician's aid and emergency surgical operations according to vital indications; hospitalization of casualties that cannot be moved; preparation of movable patients for evacuation outside the city; medical supply to formations of the MS GO operating in the section of the relevant OPM; primary records and reports and all medical documentation for this stage of the MS GO. The OPM works without relief for 2 to 5 days outside the zone of radioactive contamination or in a zone of moderate radioactive contamination provided that in four days the irradiation of personnel does not exceed 50 R. This may be 8 to 15 kilometers from the center of the nuclear strike. The personnel is moved by departments in the following order in the column: the reception-classification department (at the head of the column), the operation and bandage department, the evacuation department, the infirmary department, the laboratory, the pharmacy, and the maintenance department. The OPM has the following assignments in medical reconnaissance: determination of the existence of intact buildings and property suitable for deployment of the OPM departments; discovery of nearby sources of water supply and approach roads; determination of where each OPM department will be deployed; discovery of the situation at the center of the attack. The general assignments of the various departments of the OPM are summarized. Special attention is paid to the movement of serious and moderate casualties. (JPRS)

Medicine

Refer also to abstract 48006.

48082 PROCEEDINGS OF THE 6TH ANNUAL MEETING OF THE JAPANESE SOCIETY OF NUCLEAR MEDICINE, NOV. 7, 8, 1966, TOKYO, JAPAN. VOLUME 6. Jap. Nucl. Med., 6: 1-111(Dec. 1967). (CONF-661135-(Vol.6)).

One hundred thirty-two abstracts are presented in the field of nuclear medicine. Included are studies on apparatus, specific organs, metabolic tracers, and malignant tumors. (C.O.)

Protective Substances

Refer also to abstracts 47922, 47954, 47959, and 48203.

48083 THE ACTION OF PHYTOHEMAGGLUTININ IN VIVO AND IN VITRO: A REVIEW. Naspitz, Ch. K.; Richter, M. (Royal Victoria Hospital, Montreal). Progr. Allergy, 12: 1-85(1968).

The effects of phytohemagglutinin (PHA), an extract derived from beans of the genus Phaseolus, are reviewed (with 435 references), including accounts of the interaction of PHA and ionizing radiations on cells. The value of PHA in protection against the effects of irradiation in vivo has been investigated. A protective effect against irradiation was observed in both the rat and mouse when PHA was administered prior to whole-body irradiation; however, another investigator did not observe this radioprotective effect of PHA in mice and rats when the PHA was injected after irradiating the animals. An in vivo radioprotective effect of PHA on bone marrow was reported in 4 patients with bronchogenic carcinoma undergoing localized irradiation, of whom 2 received PHA by infusion during a 5-day period commencing prior to irradiation. An increase in the percentage of lymphocytes in the bone marrow was noted in the PHA-treated patients. Protection against the effects of irradiation by PHA in vitro has also been demonstrated. Thus, only 10% of the cells in cultures of human peripheral lymphocytes survived 6 days after 75-R irradiation; on the other hand, PHA-treated suspensions irradiated with 75 to 2400 R survived. In the PHA-treated lymphocytes, 2400 R had the same cytotoxic effect as 75 R on the untreated cells. Radioprotection of lymphocytes was observed as long as PHA was added at any time from 4 days before to 2 days after irradiation. It was shown that the radioresistance induced by PHA in human blood lymphocytes in vitro was suppressed when prednisolone was added to the culture 24 hr prior to PHA. (BBB)

48084 EXPERIENCE WITH LARGE DOSE ADMINISTRATION OF CEPHARANTHINE TO LEUKOPENIA DUE TO RADIOTHERAPY. Maeda, Kazunori; Shibata, Masahiro (National Hospital, Himeji, Japan). Rinsho To Kenkyu, 46: 979-82(Apr. 1969). (In Japanese).

Leukopenia is one of the serious disturbances involved in radiotherapy of malignant tumors. The experience with the use of cepharanthine in this disturbance is reported. Twenty-two patients with various types of malignant tumors who were undergoing ^{60}Co γ irradiation were divided into four groups. Each group was given a drip intravenous injection of cepharanthine using various treatment schedules. The administration of 40 mg given simultaneously with irradiation gave the best results. No change in the white blood cell count was observed before, during, or after irradiation. The use of cepharanthine in a large dose seemed to exert such pharmacological effects as accelerating reticuloendothelial function, neutralizing toxins, and controlling the autonomic nervous system, allergic reactions, and antibody formation. No change was observed in the leukocyte count of four cases in whom mitomycin was used in combination with cepharanthine and irradiation. (NSA of Japan)

48085 REACTIVITIES OF RADIOPROTECTIVE AMINOALKYLISOTHIURONIUM SALTS. 5. CALCULATION OF THE EXTENT OF TRANSGUANYLATION FROM pH DROP IN THE AQUEOUS SOLUTION OF 2-AMINOETHYL- AND 3-AMINOPROPYLISOTHIURONIUM SALTS. Hanaki, Akira (National Inst. of Radiological Sciences, Chiba, Japan). Chem. Pharm. Bull. (Tokyo), 17: 1146-52(June 1969).

2-Aminoethylisothiuronium (AET) and 3-aminopropylisothiuronium (APT) salts undergo, in the presence of alkali, rapid transguanylation accompanying the continuous pH drop. Since the liberation of hydrogen ion resulted undoubtedly from the transguanylation, the calculation of the extent of this transformation was attempted from the pH drop. The extent of transguanylation was expressed in the form of an equation. This equation can be used in the case of APT, which undergoes transguanylation alone. AET is cyclized along with transguanylation, and the cyclization product, 2-aminothiazoline, is able to associate with free hydrogen ion. Therefore, the pH drop observed as a result of a certain amount of transguanylation is decreased according to the increasing amount of cyclization. The equation for the calculation in the case of AET was given. (NSA of Japan)

48086 REDUCTION OF LONG TERM RADIATION LETHALITY BY MIXTURES OF CHEMICAL PROTECTORS. Maisin, J. R. (Centre d'Etude de l'Energie Nucleaire, Mol, Belgium). Atomkernenergie, 14: 226-8(July-Aug. 1969).

It was shown that radiation protection with a mixture of radioprotectors was more effective than with AET or MEA alone against both acute and late radiation death. Most of the mice irradiated with a dose of 2000 R or more died from radiation pneumonitis within 6 months. (auth)

48087 CHANGES OF THE TERMINAL VASCULAR BED DUE TO IONIZING RADIATION AND THE PROTECTIVE EFFECT OF TRI-(HYDROXYETHYL)-RUTOSIDE (A MICROCOLOR CINEMATOGRAPHIC STUDY). Klemm, J. (Univ., Munich). Zentralbl. Phlebol., 7: 89-92(Feb. 1968). (In German).

The panangiitis of the capillary system is demonstrated by means of slides and a 72 m phase contrast color film. Irradiation with fast electrons between 1000 R and 3000 R induces definite morphological and functional alterations in the granulation tissue of the rabbit's ear chamber. These alterations depend partly on the dose of radiation employed and progress differently in time. They can be influenced by Tri-(hydroxyethyl)-rutoside according to the administered dose. At the same time Tri-(hydroxyethyl)-rutoside accelerates the neoformation of the vessels. (auth)

Radiation Sickness and Injuries

Refer also to abstracts 47959 and 48261.

Radiodiagnosis

Refer also to abstracts 47679, 47882, 48052, 48073, and 48165.

48088 (SGAE-BL-32/1969) INVESTIGATION OF UPTAKE OF TRACE METALS IN NORMAL AND LEUKEMIC CELLS. Frischauf, H.; Altmann, H.; Honetz, N.; Neumann, E. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf). Apr. 1969. 9p. (In German). (CONF-680959-2). Dep.

From 12th Congress of the International Society of Hematology, New York.

Uptake of ^{54}Mn and ^{65}Zn by leucocytes was studied in normal persons and in leukemia patients. Behaviour of the two metals essentially was parallel. Untreated chronic myeloic leukemia was associated with decreased uptake; after treatment, uptake was enhanced strikingly. Untreated acute leukemia consistently showed high uptake values. (H.B.G.)

48089 (STI/PUB-193(Vol.2)) MEDICAL RADIOISOTOPE SCINTIGRAPHY. VOLUME II. Proceedings Series. Proceedings of a Symposium Held in Salzburg, 6–15 August 1968. (International Atomic Energy Agency, Vienna (Austria)). 1969. 948p. (In several languages). (CONF-680804-(Vol.2)). IAEA: $21.50; Austrian Schillings 556,-; £ 8.19.2; F.Fr. 105,40; DM 86,-.

Forty-eight papers and a bibliography were presented on medical radioisotope scintigraphy; separate abstracts were prepared for each paper. (H.B.G.)

For abstracts of individual papers see: 48113–48161.

48090 (TT-69-50007/1) POLISH MEDICAL JOURNAL, VOL. 8, NO. 1, 1969. Translated for National Library of Medicine, Washington, D. C., from selected Polish medical publications. 260p. CFSTI.

A separate abstract was prepared for one article in this journal. Thirty-six additional articles of medical interest are included. (H.L.W.)

For an abstract of the individual paper see: 48109.

48091 (UCLA-12-724, pp 43-70) NUCLEAR MEDICINE. (California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology).

Interim and final reports are presented for 22 studies conducted by the Nuclear Medicine group. The 22 studies include: Ventilation in pulmonary arterial occlusion; The treatment of Hodgkins disease of the liver with portal vein injection of radiogold; Technetium lung scanning; Thrombophlebitis—demonstration by scinti-scanning and thrombosis demonstrated; Point-to-point television in nuclear medicine; Turnover of serum globulins; Manganese absorption and retention in humans; Comparative assessment of brain tumors by angiography scanning and the scintillation camera; Localization of ^{99m}Tc pertechnetate in brain tumor cell cultures; Biomedical cyclotron facility; Assessment of the cerebral microvasculature in seizure disorders; Labeling albumin with ^{113m}In; Labeling albumin with ^{99m}Tc; Lung scintigraphy and pulmonary function studies in obstructive airways disease; Radio-

albumin microaggregates for reticuloendothelial organ scanning and function assessments; The effect of epithelial remnant and whole organ grafts of thymus in thymectomized irradiated mice; Regeneration and lymphomagenesis in thymus reticular cell grafts in the presence of Gross virus; Effects of short-term epithelial reticular cell and whole organ thymus grafts in neonatally thymectomized mice; The effects of antilymphocytic serum (ALS) on the development of lymphoma in mice; Immunological response in preleukemic mice; and Ionizing radiation and leukemogenesis in thymus grafts. A list of publications during the current report period is also given. (E.R.B.)

48092 OUTLINE OF METHODOLOGY OF TRACERS IN MEDICINE. Ermans, A. M.; Erbsmann, F. (Hopital Saint-Pierre, Brussels). Acta Chir. Belg., Suppl. 1, 8-18(1969). (In French).

Techniques employing radioisotopes in clinical diagnosis are reviewed, particularly in the use of ^{57}Co, ^{75}Se, ^{99m}Tc, ^{123}I, ^{131}I, ^{197}Hg, and ^{203}Hg. The physical properties of these isotopes are tabulated, and charts are provided, showing the decay and emission characteristics of the radioelements. Characteristics of the radioiodines and ^{99m}Tc are compared and the advantages of Tc over the use of radioiodine in some tests are explained. In double isotope studies with ^{131}I and ^{99m}Tc the difference in γ-energy (0.36 MeV vs 0.14 MeV) allows simultaneous counting by use of a spectrometer. The tissue-penetrating ability of the various γ emissions is discussed, and errors to be avoided in counting techniques are considered. (BBB)

48093 STUDIES ON THE ULTRASONIC DIAGNOSIS IN SURGERY. PART 2. ULTRASONIC DIAGNOSIS OF LIVER DISEASE COMBINATING WITH COLLOIDAL ^{198}Au HEPATOSCINTIGRAM AND USING THE ULTRASONIC CONTACT COMPOUND SCOPE. Chikuba, Hiroshi (Okayama Univ., Okayama City, Japan). Okayama-Igakkai-Zasshi, 80: 1080-90(Dec. 1968). (In Japanese).

Investigations were carried out by combining ultrasonic diagnosis with hepatoscintigram. The point of this method is to improve the weak points of hepatoscintigram and ultrasonic diagnosis. By means of hepatoscintigram, every large lesion (more than 2 to 3 cm in diameter) in liver can be seen but the depth and structure of the lesion can not be recognized, however the ultrasonic A-scope method is able to clarify this. Combining the methods of ultrasonic A-scope with hepatoscintigraphy gave good results for liver disease. But the nature of the echoes obtained from various kinds of livers tends to overlap. Therefore it is difficult to distinguish accurately in all cases. In some cases, examinations of malignant tissues showed only the surface and bottom echoes. The result of operation actually showed the metastatic cancer of liver, corresponding with the echogram. This fact suggests there are various degrees of absorption of ultrasound among cancers. (E.R.B.)

48094 CASUISTIC CONTRIBUTION TO THE DIAGNOSTIC VALUE OF GASTRIC SCINTIGRAPHY. Hell, K.; Fridrich, R.; Gruber, U. F. (Chirurgische Univ., Basel). Schweiz. Med. Wochensch., 99: 816-18(May 31, 1969). (In German).

Applications of ^{99m}Tc in gastric scintigraphy are discussed. Following intravenous injection, ^{99m}Tc is first taken up by the stomach wall, and then is secreted into the stomach lumen. The amounts of ^{99m}Tc secreted seemed to be related to the amount of gastric juice produced. Because of this, inflammatory conditions, whether diffuse or localized, do not affect ^{99m}Tc transport. Gastric wall neoplasms do not have the ability to incorporate or transfer ^{99m}Tc, because their function is partially or totally destroyed. Neoplastic areas of the stomach show lack of uptake of ^{99m}Tc. Also, intragastrically located processes absorb the soft γ radiation of the ^{99m}Tc. Ingesta or coagula located in the gastric area cause nonhomogenous distribution of the scintigram activity. Large polyps or exophytic, growing processes appear as areas of decreased ^{99m}Tc activity. It was shown in clinical use that tumors located on the external portion of the stomach wall also do not incorporate ^{99m}Tc, and appeared as areas of low activity in the scintigram. (BBB)

48095 LIVER SCINTIGRAPHY WITH ^{113m}In. Fridrich, R.; Spindel, A. (Univ., Basel). Schweiz. Med. Wochensch., 98: 1928-31(Dec. 7, 1968). (In German).

The sulfur colloid of ^{99m}Tc has had advantages for scintigraphic use because of its favorable physical half-life and high localization in liver. However, this colloid and the ^{99m}Tc–Sb sulfide colloid have been shown to have some toxic side effects. The ^{99m}Tc–Sb sulfide colloid was deposited in liver more rapidly than ^{113m}In and the peak deposition was observed to take place 20 min after injection. Its effective half-life was 5.1 hr. The blood clearance was also faster than that of ^{113m}In. The irradiation dose from ^{99m}Tc was 0.4 R/mCi, and with ^{113m}In it was 0.5 R/mCi. (BBB)

48096 DETERMINATION OF RENAL CLEARANCES WITH RADIOACTIVE DIATRIZOATE, EDTA AND o-I-HIPPURIC ACID USING THE SINGLE INJECTION TECHNIQUE. Speck, B. (Buergerspital, Solothurn, Switzerland). Helv. Med. Acta, 34: 486-97 (Mar. 1969).

A new technique employing a double-isotope principle was used for determining renal clearance. It was developed to replace the cumbersome and time-consuming standard renal clearances by a simple, and yet reliable and reproducible method. Because of its simplicity and because no bladder catheterization is required, a single injection technique was used. The technique uses ^{131}I-Hippuran for determination of effective renal plasma flow (ERPF) and ^{131}I-diatrizoate for the glomerular filtration rate (GFR). In the high normal range of results, the discrepancies between the standard p-aminohippuric acid (PAH) and the single-shot ^{131}I-Hippuran clearance were significant. However, these discrepancies bear little clinical significance. The correlation between the standard inulin clearance and the single injection technique using ^{131}I-diatrizoate in normal individuals was good (r = 0.91). The results of the GFR determined with ^{131}I-diatrizoate using the single injection technique also correlated well with those obtained with ^{51}Cr-EDTA (r = 0.96). Repeated determinations of the ERPF using the single injection technique with ^{131}I-Hippuran yielded an excellent correlation coefficient (r = 0.978), and repeated determinations of the GFR with ^{131}I-diatrizoate an r of 0.981. Because of their simplicity and reproducibility, the use of the single injection clearances is warranted in clinical medicine. (BBB)

48097 DELAY OF THE MAXIMUM IN ISOTOPE RENOGRAMS. Laub, J.; Magnus, H. (Staedtische Krankenanstalten, Karlsruhe, Ger.). Roentgenpraxis, 22: 183-7(Aug. 1969). (In German).

Renograms were recorded following the injection of 0.4 mCi ^{131}I-Hippuran. In 142 patients, the maximum was delayed. These cases were divided as follows: essential hypertonia 42.5%, unilateral renal shutdown 28%, pyelonephritis 20.5%, and space occupying processes 9%. Increase and delay of the maximum in renograms, when the contralateral kidney lost its function, was caused by a compensatory process; therefore, the renogram should not be interpreted as a pathologic condition. In the case of pyelonephritis and space occupying lesions, delay of the renogram maximum was considered an intrarenal constriction of urinary excretion. (H.B.G.)

48098 ANALYSIS OF RESOLVING POWER IN MEASUREMENTS OF RADIOACTIVITY WITH THE ANGER SCINTICAMERA. Malesa, Jan (Inst. of Oncology, Warsaw). Pol. Rev. Radiol. Nucl. Med., 32: 520-7(1968).

An analysis of the possibilities of measurements with the γ scintillation camera is presented. The static character of radioactive decay is considered. (auth)

48099 FILLING DEFECTS ON SCINTILLATION SCANS OF THE LIVER ASSOCIATED WITH DILATATION OF THE BILE DUCTS. Gammill, Stephen L. (Tulane Univ., New Orleans); Maxfield, William S.; Font, Robert G.; Sparks, Robert D. Amer. J. Roentgenol., Radium Ther. Nucl. Med., 107: 37-42(Sept. 1969).

The case reports of four patients with filling defects on liver scanning associated with dilatation of the common bile duct and liver radicals are presented. Three patients had obstruction of the common bile duct; one because of a stone and the other two because of carcinoma of the pancreas. The other patient had a choledochal cyst. When there is a filling defect in the liver hilum on a liver scan, enlargement of the common bile duct and intrahepatic biliary radicals should be considered as a possible cause. Percutaneous cholangiography should be done on these patients, to establish whether extrahepatic obstruction is the cause of the defect shown on the scan. (auth)

48100 FUNCTIONAL HEPATOMA DEMONSTRATED WITH ROSE BENGAL SCANNING. Shoop, Jon D. (Univ. of New Mexico, Albuquerque). Amer. J. Roentgenol., Radium Ther. Nucl. Med., 107: 51-3(Sept. 1969).

The case of a 54 year old male with a well-differentiated liver cell carcinoma is presented. That the region of carcinoma was revealed on scanning utilizing rose bengal labeled with ^{131}I as an area of normal to increased activity, contrasting with the liver background of decreased uptake due to fibrosis and degeneration, is felt to be a unique instance of function of an hepatic cell carcinoma. (auth)

48101 PSEUDOABNORMAL LIVER SCANS SECONDARY TO RESIDUAL BARIUM IN THE BOWEL. Seymour, E. Quitman; Puckette, S. E. Jr.; Edwards, Jean (Medical Coll. of South Carolina, Charleston). Amer. J. Roentgenol., Radium Ther. Nucl. Med., 107: 54-5(Sept. 1969).

Residual barium in the bowel, when superimposed over the liver, can produce localized areas of decreased uptake on a scan and

thereby a false positive finding. This was detected clinically and confirmed by experimental means. A scout roentgenogram of the abdomen is recommended immediately prior to the scanning of abdominal organs. (auth)

48102 ON THE LUNG-SCAN. Horvath, K. (Szivkorhaz, Balatonfuered, Hungary); Babiczky, T.; Ludvigh, K.; Horvath, M.; Kocsar, L.; Kutas, V. Atomtech. Tajek., 12: 31-42(Jan. 1969). (In Hungarian).

A review on the results achieved in Hungary and abroad in lung-scan examinations is presented and a report on the authors' experiments, description of the equipment applied, and a discussion of the possibilities of using other new equipment for pulmonary scintigraphy are given. (TSS)

48103 SENSITIVITY AND RESOLUTION IN RADIOISOTOPE SCANNING. MacIntrye, W. J. (Case Western Reserve Univ., Cleveland); Fedoruk, S. O.; Harris, C. C.; Kuhl, D. E.; Mallard, J. R. Nucl.-Med., 8: 99-146(July 15, 1969).

Concepts of resolution and sensitivity that appear compatible with both moving-detector scanners and stationary-detector devices were developed. While the sensitivities measured from various sources were described, plane sensitivity was selected as the one most useful for system comparison. The line spread function and the modulation transfer function derived from it were selected to provide the description of the resolution of the system or for any component of the system. Both theoretical and practical considerations of the application of these concepts to moving-detector scanners and stationary-detector devices are discussed. (auth)

48104 THE USE OF A DESK-TOP COMPUTER FOR ROUTINE CALCULATIONS IN A CLINICAL RADIOISOTOPE LABORATORY. Roos, P. (Vrije Univ., Amsterdam). Nucl.-Med., 8: 147-53(July 15, 1969).

The usefulness of a desk-top computer for routine calculations in a clinical radioisotope laboratory is demonstrated. Main advantages are a large gain in time and an increase in precision. Examples of calculations presented include ^{131}I thyroid function tests in vivo and in vitro, determination of the apparent half-life of ^{51}Cr-marked erythrocytes, radioimmunoassay of serum insulin levels, saturation analysis of serum vitamin B_{12} levels and a few special programs having a wide applicability. (auth)

48105 COMPUTER RENOGRAPHY. A PROGRAM FOR AUTOMATIC EVALUATION OF ISOTOPE-RENOGRAPHY. Winkler, C.; Knopp, R.; Schulte, P. (Univ., Bonn). Nucl.-Med., 8: 154-65(July 15, 1969). (In German).

Evaluation of renograms can be performed more objectively and less time consuming by means of a digital computer. For this purpose a computer program has been developed which is based on Boole's logic. Application of the program leads to an automatic calculation of the diagnostic renogram result, and furthermore to a medical record printout by teletypewriter. In addition, renogram data together with the name of the patient, his identification number, etc., are stored on magnetic tape for later clinical and/or scientific use. The program was written in the language PROSA for a Siemens 305 Computer. It is, however, also translated in FORTRAN and an ALGOL-version will be prepared in the near future. Testing of the usefulness of computer renography and its application will therefore be possible with any digital computer. (auth)

48106 SCINTIGRAPHY OF SYMPTOMLESS METASTASES OF MAMMARY CANCER IN THE SPINE. Malinowska, J.; Mackiewicz, H.; Siwicki, H.; Jasinski, W. K. (Inst. of Oncology, Warsaw). Nucl.-Med., 8: 179-86(July 15, 1969).

Preliminary results of the routine scintigraphic search for symptomless bone metastases in breast cancer patients in the Institute of Oncology, Warsaw, for radiotherapy, as performed regardless of the advancement of the disease and the type of treatment are reported. 103 patients were examined in 12 months. Five selected cases are described and briefly discussed, and respective scans are shown. It is concluded that scintigraphy enables demonstration of symptomless metastases of cancer of the breast in bones, which is of utmost importance for establishing realistic prognosis and for planning of proper treatment. (auth)

48107 ISOTOPE DIAGNOSIS IN NEUROSURGERY. Wilcke, O. (Univ., Cologne. Max-Planck-Institut fuer Hirnforschung, Cologne). Acta Neurochir., 15: Suppl., 1-160(1966). (In German).

Various radioisotopes, especially ^{131}I-albumin, positron emitters like copper-64 and ^{74}As, as well as ^{203}Hg have improved neurological diagnostic procedures considerably. As yet, none of the isotopes was clearly superior to any of the others. Based on the examination of 2,200 patients, brain tumors were diagnosed with an accuracy of 77%; the absence of brain tumors with 88%. When combined with EEG, radioisotope diagnosis of brain tumors reached an accuracy of 89%. In the remaining 11%, neurological findings or skull x-ray pictures indicated space occupying lesions. Therefore, for screening purposes, brain tumors were excluded when normal results are yielded by neurologic examination, EEG, radioisotope scanning, and routine roentgenological skull films. The diagnostic value of radioisotope procedure was low in the case of cerebellar tumors. Fistulae of the cerebrospinal fluid system were easily demonstrated with radioisotopes that are less hazardous than dyes. For myelographic purposes, radioisotope procedures were thus far inferior to examination by contrast media. Advantageous was the application of isotopes for determination of cerebral blood flow, oxygen consumption, and vascular resistance. Decreased blood flow was characteristic for brain tumors and arteriosclerotic processes; increased blood flow was found in angiomas and aneurism. (H.B.G.)

48108 THE BASAL AND STIMULATED INTRAGASTRIC SECRETION OF ^{131}I IN DUODENAL ULCER. Szantay, I.; Cotul, S.; Fodor, O.; Popescu, S. (Third Medical Clinic, Cluj). Rev. Roum. Med. Interne, 5: 395-402(1968). (In French).

The secretion of ^{131}I by gastric mucosa was studied in 10 healthy human subjects and in 20 with duodenal ulcer. The thyroid radioiodide uptake was blocked by a 1-g dose of KI 24 hr before administration of $Na^{131}I$ in a single dose of 1 μCi/10 Kg body weight. Intragastric secretion of HCl and ^{131}I was followed under basal conditions and after histamine (0.004 mg/Kg) and insulin (10 units) stimulation. A sample of gastric juice was aspirated at 15-min intervals. The secretion of ^{131}I and HCl ran parallel in the ulcer patients and ^{131}I secretion was higher than in normal subjects. After histamine or insulin stimulation, gastric secretion of ^{131}I fell while that of HCl rose. These results suggest that under conditions of maximal HCl secretion, the parietal cells of the stomach exert a selectivity of Cl ion secretion over that of ^{131}I. (BBB)

48109 INVESTIGATIONS BY THE USE OF RADIOACTIVE COPPER (^{64}Cu) IN CHRONIC LIVER DISEASES. Wysocki, K.; Owczarek, L.; Gorski, S.; Kurnatowska, A. (Medical Academy, Poznan, Poland). Pol. Med. J., 8: 43-9(1969).

Translated from Pol. Arch. Med. Wewn., 40: No. 3, 1968.

Radioactive copper (^{64}Cu) was used for investigations in chronic liver diseases, Wilson's disease and in subjects with healthy liver. Following intravenous injection of the isotope, radioactivity was measured over the heart and liver. It was observed that in chronic liver diseases, particularly in Wilson's disease, the uptake of radioactive copper by the liver was initially much lesser, as compared with the control group. In later hours, the pattern of radioactivity uptake differed markedly, according to the form of Wilson's disease and the type of liver cirrhosis. In subjects with healthy liver, in later hours, the curves representing radioactivity over the heart showed a steady increase. In liver cirrhosis, intermediate values were observed. (auth)

48110 CRITICAL EVALUATION OF RENAL NUCLEAR DIAGNOSTIC METHODS IN PEDIATRICS. Hoer, G. (Univ., Munich). Arch. Kinderheilk., 176: 263-80(Jan. 1968). (In German).

Based on several years of experience in the work with isotope nephrography and renal scintigraphy during childhood, the conclusions are stated with respect to the question of the acceptability of such methods of nuclear medicine. A general basis for the well documented acceptability of indications is outlined, particularly in disorders of the urinary tract where there are correctable anomalies amenable to surgery. Some criticism is also offered together with examples of retrospectively unjustifiable indications. The present knowledge about the irradiation to the body by methods of nuclear diagnosis during childhood is reviewed. Possibilities of prophylactic measures and for a reduction of the respective irradiation are discussed and the need emphasized for a particularly critical approach to the indication of such investigations. (auth)

48111 DC DEFIBRILLATION OF ATRIAL FIBRILLATION AND ITS HEMODYNAMICAL EFFECTS, STUDIED BY RADIOISOTOPE DILUTION METHOD. Takahashi, Torao (Nagoya Univ., Japan). Jap. Circ. J., (Engl. Ed.), 33: 251-73(Mar. 1969).

DC cardioversion for chronic atrial fibrillation was carried out in 32 patients for 58 times using a R-synchronized DC cardioverter. The cardioversion was successful in 49 trials out of 58 (85%) and, in 29 patients of 32 (91%). Nineteen (33% of 58 trials or 59% of 32 patients) have maintained normal sinus rhythm for the period ranging from two months to 2 yr. There was no intimate relation between the success or maintenance rate of cardioversion and the severity of the underlying disease indicated by functional classifi-

cation, duration of atrial fibrillation, cardio-thoracic ratio in chest film or preoperative mean left atrial pressure. The most important factor that determined the results of cardioversion was surgical correctability of underlying disease. Quinidine administration at a maintenance dose appeared to be of limited value for the long-term result of successful cardioversion. Resting cardiac index showed slight or not so remarkable increase with cardioversion, although, it showed significant (+ 24%) increase in exertional cardiac index. Circulating blood volume increased 3 to 4% at rest and 8% on exercise with restoration of normal sinus rhythm. There seemed to be a risk of causing lung edema for the patient of disturbed mitral function with this increase. Mean pulmonary circulation time showed 18% of shortening at rest and 16% on exercise. Stroke volume on exercise remained unchanged in comparison to the resting level after cardioversion, while it showed remarkable decrease during arrhythmia. This means that increase of heart rate with exercise results in an increase of cardiac output after cardioversion. Atrial fibrillation should be converted immediately after surgical repair of the underlying diseases. Even if recurrence follows within a few days, normal sinus rhythm can be expected to bring some benefits to patients in the postoperative crisis. No remarkable complication was experienced during this study. (NSA of Japan)

48112 EARLY DIAGNOSIS, F ACUTE PANCREATITIS WITH ^{85}Sr. EXPERIMENTAL STUDIES. Rossi, R.; de Marzo, V.; Ferri, O. (Univ., Milan). Arch. Ital. Chir., 94: 274-90(1968). (In Italian).

A method for early diagnosis of acute pancreatitis is presented. This method is based on the study of the distribution of ^{85}Sr used as a tracer for the calcium, injected in animals, knowing the precipitation phenomena of calcium in tissues affected by inflammatory and necrotic processes. In 34 dogs in which acute pancreatitis was experimentally induced by various methods, it was possible to demonstrate a rapid and selective accumulation of the tracer in the pancreas, proportional to the extent of the induced lesion. The radio-strontium concentration in the pancreas, is so much higher than in other organs that this simple technique can be adapted for an early and reliable diagnosis of the disease in man. (auth)

48113 DESIGN AND DEVELOPMENT OF NEW RADIOPHARMACEUTICALS. Wagner, H. N. Jr.; Stern, H. S.; Rhodes, B. A.; Reba, R. C.; Hosain, F.; Zolle, I. (Johns Hopkins Medical Institutions, Baltimore). pp 3-24 of Medical Radioisotope Scintigraphy. Vol. II. Vienna, International Atomic Energy Agency, 1969.

From Symposium on Medical Radioisotope Scintigraphy, Salzburg, Austria. See STI/PUB-193(Vol.2); CONF-680804-(Vol.2).

The major factors in the design of a new radiopharmaceutical for radioisotope scintigraphy are the photon energy of the radionuclide, the ability to incorporate the radionuclide in suitable chemical and biological form, the radiation dose to the patient, and the cost of production of the radiopharmaceutical. The radionuclides, ^{113m}In, ^{169}Yb, and ^{99m}Tc, are incorporated into a variety of radiopharmaceuticals. These include particles suitable for lung and liver studies, chelates for brain and kidney studies, and ionic forms for blood pool imaging. Studies in experimental animals and man indicate that these agents offer certain advantages over previously available radiopharmaceuticals. By providing larger numbers of photons, they permit more precise temporal and spatial resolution. The longer half-life of the ^{113}Sn parent radionuclide from which ^{113m}In can be eluted makes ^{113m}In readily available, even at sites distant from the source of production. The tin-indium generator system need be purchased only every five months rather than weekly as in the case of the widely used molybdenum-technetium system. The ytterbium-radionuclide in the chemical form of a chelate is particularly useful as an inexpensive agent that provides high photon yields for renal and brain imaging. The rapid and complete biological excretion results in low radiation dose while the longer physical half-life greatly extends the shelf-life. (auth)

48114 RADIOIODINATED SYNKOL AS A TUMOUR-LOCALIZING AGENT. Ganatra, R. D.; Ramanathan, P.; Patel, M. C.; Mehta, M. N.; Shahani, S. N.; Sharma, S. M.; Mani, R. S.; Noronha, O. P. D.; Blau, M. (Bhabha Atomic Research Centre, Bombay). pp 25-41 of Medical Radioisotope Scintigraphy. Vol. II. Vienna, International Atomic Energy Agency, 1969.

From Symposium on Medical Radioisotope Scintigraphy, Salzburg, Austria. See STI/PUB-193(Vol.2); CONF-680804-(Vol.2).

Tetrasodium 2-methyl-1,4-naphthaquinol diphosphate (Synkavit) is recognized as a chemical radiosensitizer and this property is attributed to its specific localization in the malignant cells. Our earlier experiments in developing a radioiodinated derivative of this compound showed that the radioiodine label on this compound was labile. The possibility of using an analogue of this compound, known as synkol (6-hydroxy 2-methyl 1,4-naphthaquinone), as a tumor-localizing agent is investigated. The radioiodinated synkol appeared to be stable in in-vitro and in-vivo experiments. The distribution studies with the labeled compound in mice having spontaneous mammary adenocarcinoma or transplanted fibrosarcoma showed 10 and 5% of the administered dose in the tumor at 2 and 24 hr after oral or intraperitoneal administration. It was possible to delineate the tumor in these animals by scanning. In fact, at 24 hr the tumor was the only remaining tissue with a high concentration of the radioisotope. Radioiodinated synkol was administered orally to a series of patients with malignancies at different sites. The scans obtained in these patients are presented. (auth)

48115 ^{11}C IN BONE AND LUNG SCANNING. Myers, W. G.; Hunter, W. W. Jr. (Ohio State Univ., Columbus). pp 43-55 of Medical Radioisotope Scintigraphy. Vol. II. Vienna, International Atomic Energy Agency, 1969.

From Symposium on Medical Radioisotope Scintigraphy, Salzburg, Austria. See STI/PUB-193(Vol.2); CONF-680804-(Vol.2).

Radiocarbon-11 decays with 20.3-min half-life by emitting positrons with 1.0-MeV maximum energy. Two 511-keV ± γ-photons almost always are emitted coincidentally with each disintegration, at 180° to each other. This relationship makes it possible readily to locate small accumulations of ^{11}C in vivo by opposed detectors connected by coincidence circuitry. The calculated narrow-beam half-thickness in water is more than 7 cm, to provide good penetration from deep organs, and with little scatter. Multimillicurie amounts of a mixture of ^{11}CO and $^{11}CO_2$ are generated readily in our small cyclotron when probe targets of B_2O_3 are bombarded with protons, deuterons, or $^3He^{2+}$ ions. The ^{11}CO is oxidized to $^{11}CO_2$ by hopcalite placed in the vacuum line. Dogs with primary or metastatic bone tumors received $^{11}CO_2$, either by inhalation in a closed system, or in slightly basic solution intravenously. Scintigraphs, that were obtained within 10 to 20 min by means of a Nuclear-Chicago focused-collimator scanning machine, revealed significant accumulations of ^{11}C at sites where bone erosion was demonstrable roentgenographically. Good pictures of dog lungs were obtained either with the mechanical scanner, or with our Nuclear-Chicago scintillation camera, after intravenous injection of 4 to 12 μm diameter smoothly-rounded aggregates of $SrCO_3$ that were formed in dextran-saline solution. These "photon carrier" aggregates were made either with ^{11}C; or with 2.8-hr ^{87m}Sr, that emits 388-keV γ rays. Alternatively, they might be made to carry the 231-keV γ rays of 70-min ^{85m}Sr that are advantageous for scintigraphy. The advent of Anger's positron camera, with choice of plane of prime interest, will provide opportunities to emphasize the maximum target/nontarget ratio in pictures of localized accumulations of ^{11}C, as well as of ^{13}N, ^{15}O, and other cyclotron-produced short-lived β^+-isotopes of abundant physiologically important elements. (auth)

48116 QUANTITATIVE RADIO-CARDIOGRAPHY WITH THE DIGITAL AUTOFLUOROSCOPE. Bender, M. A.; Moussa-Mahmoud, L.; Blau, M. (Roswell Park Memorial Inst., Buffalo). pp 57-61 of Medical Radioisotope Scintigraphy. Vol. II. Vienna, International Atomic Energy Agency, 1969.

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The Digital Autofluoroscope was designed primarily to permit a quantitative evaluation of the rapid flow of short-lived radioisotopes through compartments within organs. To perform these studies, the instrument is operated in the dynamic mode. In this mode the patient is positioned in front of the detector, the radioactive material is administered, and the instrument automatically accumulates data in a magnetic core memory for a preset period of time varying from 30 milliseconds to 1 minute. At the end of the accumulation period, the stored information is dumped on computer-compatible digital magnetic tape, the memory is cleared, and a new accumulation cycle commences. Upon completion of a study, the tape is replayed and anatomical sites identified from the images of the distribution of the radioactive material. A memory flagging system is then used to obtain quantitative information on a regional basis. Radio-cardiograms are performed following the intravenous injection of a bolus of 10 millicuries of ^{99m}Tc, and rapid sequence recording of the cardiac inflow and outflow data is obtained at the rate of five frames per second. Upon completion of the study, the digital tape is played back and the locations of the four chambers of the heart are identified. The memory elements corresponding to each of these anatomical sites are then flagged, the data are replayed, and the inflow and outflow curves for each chamber are recorded separately. An EKG trigger device can be used to initiate every count-record cycle to permit the accumulation of data only during diastole. The resulting data are easier to interpret, as changes in cardiac volume due to normal contractions are not re-

corded. This technique has been evaluated in 20 volunteers to establish normal values. Over 50 patients with congenital and acquired heart disease have been studied, and the following parameters evaluated: cardiac output, pulmonary blood transit time, pulmonary blood volume, and the quantitation of blood flow through abnormal shunts. (auth)

48117 INVESTIGATION OF CARDIAC DYNAMICS USING SCINTILLATION CAMERA AND COMPUTER. Adam, W. E.; Schenck, P.; Kampmann, H.; Lorenz, W. J.; Schneider, W. G.; Ammann, W.; Bilaniuk, L. (Medizinische Hochschule, Ulm, Ger. Institut fuer Nuklearmedizin, Heidelberg). pp 77-91 of Medical Radioisotope Scintigraphy. Vol. II. Vienna, International Atomic Energy Agency, 1969.

From Symposium on Medical Radioisotope Scintigraphy, Salzburg, Austria. See STI/PUB-193(Vol.2); CONF-680804-(Vol.2).

Until recently radiocardiography has been performed with NaI detectors placed over the cardiac region, or parts of it. The measurement of the distribution of radioactivity with the Anger camera permits examination of the entire heart or parts of it under concurrent visual control. The data from the Anger camera are stored on analogue magnetic tape. Upon completion of the examination the data are fed via two analogue-digital converters into the 32 × 32 word memory of a PDP-8 computer. From the time sequence of the digital scintigrams, the course of the radioactivity in the area under observation can be measured quantitatively. This method allows the measurement of the flow of the tracer substance through the right atrium and ventricle, as well as through the left chamber of the heart. Investigations were carried out with mechanical heart models with one and four compartments. It was possible to determine the output volume and size of each compartment. The curves obtained could be compared with those from an analogue computer simulating the tracer passage through the heart. Investigations of the human heart are more difficult, because parts of the various compartments overlap. By taking pictures in the 2nd oblique diameter it was possible to get parts of the left and the right ventricle free from overlapping. The curves obtained in these representative areas were not influenced by the passage of the tracer through other compartments. The methods of radiocardiography and quantitative cardioscintigraphy were compared. The latter method proved to be more advantageous. (auth)

48118 COMPARATIVE STUDY OF REGIONAL LUNG FUNCTION WITH INTRAVENOUS INJECTION OF ^{131}I-LABELLED MACROAGGREGATED ALBUMIN AND ^{133}Xe. Cederquist, E.; Naversten, Y.; White, T. (Univ. of Lund, Sweden). pp 125-9 of Medical Radioisotope Scintigraphy. Vol. II. Vienna, International Atomic Energy Agency, 1969.

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In each of 22 patients with known or suspected lung disease, regional lung perfusion was assessed by measuring the radioactivity over the lower and upper part of each lung after intravenous injection of ^{133}Xe and by scanning after intravenous injection of macroaggregated serum albumin labeled with ^{131}I. Which of the two methods was best suited as a clinical routine procedure in cases where information about regional lung function was required, e.g., in patients in whom lung surgery was considered was investigated. Direct comparison of results was possible only for lung perfusion. The xenon technique, but not the macroaggregate serum albumin technique, measures ventilation in addition. There was good agreement between the two methods in those instances where the perfusion ratio, left lung/(left lung + right lung), was normal, i.e., near 0.5. On the other hand, there were discrepancies in patients with great difference between the perfusion of the two lungs. It is concluded that scanning after injection of macroaggregates is the method to be preferred in hospitals that have facilities for scintigraphy. (auth)

48119 CONTRIBUTION OF PERFUSION SCINTIGRAPHIC STUDIES TO THE DIAGNOSIS AND MANAGEMENT OF PULMONARY EMBOLISM. Morris, J. (Royal Prince Alfred Hospital, Sydney. Univ. of Sydney). pp 145-53 of Medical Radioisotope Scintigraphy. Vol. II. Vienna, International Atomic Energy Agency, 1969.

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Pulmonary scintigraphy was performed in 1000 patients with suspected pulmonary embolism. When possible, simultaneous radiological electrocardiographic and respiratory function studies were carried out. When a final diagnosis of pulmonary embolism was made, serial studies were recommended. Macroaggregated ^{131}I-labeled human serum albumin and ^{113m}In-labeled ferric hydroxide in a dosage of 100 to 300 μCi and 1.5 mCi respectively was administered intravenously in most cases with the patient supine. Commercial scintiscanners with 3-in. and 5-in. crystals and a scintillation camera were used. In most cases scintigraphy was done with the patient in the prone position; lateral views were done when considered useful, and when the patient was not able to tolerate the prone position, the supine or sitting position was used. When operative or autopsy confirmation was not available the final diagnosis was based on a joint consideration of the total clinical, radiological, electrocardiographic, respiratory function, and scintigraphic data. Many disease processes were shown to interfere with pulmonary arterial perfusion as depicted by pulmonary scintigraphy. Some patterns of radioisotope distribution were suggestive of pulmonary embolism but not one was specific. Most accurate interpretation was achieved when scintigraphic data were examined in conjunction with the clinical, radiological, electrocardiographic, and respiratory function studies. This mostly overcame the non-specificity of the scintigraphic patterns. Serial scintigraphic studies often clarified the diagnosis but were most useful in monitoring the progress of disturbances of pulmonary arterial perfusion in pulmonary embolism. Scintigraphic studies have provided a simple means of making a major contribution to the diagnosis of this commonly fatal and often undiagnosed disease; in addition it provides an accurate method for evaluating the efficacy of therapy. The continued application of scintigraphic techniques should reveal the true incidence and behavior of pulmonary embolism. (auth)

48120 LUNG SCANNING IN EVALUATING INTRATHORACIC TUMOURS. Samaras, Vrisiis; Dontas, N.; Dermentzoglou, Flora M.; Sawas-Dimopoulou, Christine (Greek Atomic Energy Commission, Athens. Greek Anticancer Inst., Athens). pp 155-63 of Medical Radioisotope Scintigraphy. Vol. II. Vienna, International Atomic Energy Agency, 1969.

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Lung scanning was performed after injecting 200 to 300 μCi of ^{131}I-labeled macroaggregated human serum albumin. The particles should be between 10 and 60 μm; they averaged from 20 to 25 μm and were kept between 2 and 4°C. The Nucor Mediscanner, Model C4004C, and the Picker Color Magnascanner III were used. A group of intrathoracic tumors, mainly bronchogenic carcinomas, before and after x-ray treatment are investigated. In centrally located bronchial carcinomas there was a marked diminution of blood flow not only to the diseased lobe, but also to the affected lung. Reduction of pulmonary vasculature was marked even in cases where atelectasis was not apparent. On the contrary, peripheral neoplastic lesions produced only a minimal alteration in the lung scanning, which corresponded to the affected area. A decrease of blood flow was also demarcated in neoplastic growths after cobalt treatment. This was due to the fibrotic obstruction of the arterial supply of the diseased lobe. An enlarged upper mediastinum was noticeable in cases in which this area was specifically irradiated. (auth)

48121 PULMONARY SCINTIGRAPHY FOR TUMOR DIAGNOSIS. Esteban, J.; Lasa, D.; Herranz, R.; Galvez, F.; Negueruela, J.; Perez-Modrego, S. (Hospital Oncologico Provincial, Madrid). pp 165-82 of Medical Radioisotope Scintigraphy. Vol. II. Vienna, International Atomic Energy Agency, 1969. (In Spanish).

From Symposium on Medical Radioisotope Scintigraphy, Salzburg, Austria. See STI/PUB-193(Vol.2); CONF-680804-(Vol.2).

Scanning of the lungs with albumin aggregates is one of the most useful methods for studying variations in pulmonary circulation and diagnosing embolisms and infarcts. However, its utilization for the diagnosis of tumors is barely in the trial stage. Using scintillation scanning, patients with primary pulmonary tumors and secondary tumors at other sites were studied and it was observed that the tracer distribution pattern differs fundamentally according to the type of tumor. With metastatic tumors, the repercussion of the lesions in scintillation scanning is slight and is entirely dependent on the volume of the zone of condensation. The tumorous nodules behave entirely like inactive zones within a mass of active functional parenchyma and their effect on the scanning image depends solely on the size of the tumorous region and the amount of healthy parenchyma intervening between it and the detector. With primary pulmonary tumors and more especially those located in the hilar region, relatively small lesions give rise to defects in uptake in extensive areas of the lung, and these may affect various segments, a lobe, or even the entire lung. This decrease in uptake cannot be entirely explained by the image of the tumor or by the associated zones of atelectasia, but must be due to serious alteration in the haemodynamics of the lung affected. Various kinds of phenomena associated with tumorous development may cause vascular changes affecting even the periphery of the lung: changes in breathing conditions accompanied by a reduction of oxygen tension, leading to change in haemodynamic condi-

tions; pulmonary hypertension through compression of the veins in the lungs which are less resistant than the arteries; and direct nervous stimulation due to irritation of the bronchial plexi as a result of the growth of the tumor and associated reactive phenomena. (auth)

48122 SIMILAR LUNG SCANS FROM DIFFERENT CLINICAL CONDITIONS. Zita, Gerlinde (Lainz Hospital, Vienna). pp 183-8 of Medical Radioisotope Scintigraphy. Vol. II. Vienna, International Atomic Energy Agency, 1969.

From Symposium on Medical Radioisotope Scintigraphy, Salzburg, Austria. See STI/PUB-193(Vol.2); CONF-680804-(Vol.2).

The problems that still arise in lung scintigraphy as a result of the discrepancies between scan interpretations and clinical observations are described. On the basis of data obtained from 500 cases of common and rare lung diseases it was found that different groups of diseases can produce similar or identical scintigrams. However, because of the wide range of variation it was not possible to work out a typical distribution pattern. After discussing significant examples, reference is made to the special case of scintigrams which represent two or more diseases. It is suggested that patho-physiological factors may provide a possible explanation of the similar scans from cases with a different clinical origin. In addition, as a more positive feature, a comparison is made with the results of other lung examinations or scintigraphic checks carried out during the course of a disease; this made it possible to introduce differential-diagnostic considerations in discussion with the clinicians and to derive more information from the scans. (auth)

48123 DETECTION OF MYOCARDIAL INFARCTS BY IN-VIVO SCANNING USING MERCURASCAN. Vavrejn, B. (Research Inst. for the Medical Use of Radioisotopes, Prague); Malek, P.; Ratusky, J.; Kronrad, L.; Kolc, J. pp 189-94 of Medical Radioisotope Scintigraphy. Vol. II. Vienna, International Atomic Energy Agency, 1969.

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A method is described in which mercurascan (a hydroxymercury derivative of fluorescein) is injected intravenously into dogs before scanning so as to detect myocardial infarction as a hot area on the scan. Experiments with some 150 dogs show that myocardial ischaemia could be demonstrated by in vivo scanning within a short period of time after administration of mercurascan. (auth)

48124 LOCALIZATION STUDIES AFTER RENAL TRANSPLANTATION. Hoer, G.; Pabst, H. W.; Haubold, U. (Univ., Munich). pp 209-17 of Medical Radioisotope Scintigraphy. Vol. II. Vienna, International Atomic Energy Agency, 1969.

From Symposium on Medical Radioisotope Scintigraphy, Salzburg, Austria. See STI/PUB-193(Vol.2); CONF-680804-(Vol.2).

Patients with renal transplantations were scanned to study the localization and rejection of the transplant. The interval between the transplantation and the isotope examination ranged from 3 weeks to 12 months. Photoscanning may offer the possibility of evaluating the functional status of renal transplants; this procedure also adds information concerning the configuration and localization of the transplant as well as its relation to the urinary bladder. Renal transplants should be scanned within the first days or weeks after the transplantation to determine whether rejection is likely. Long-term observations are also of interest; a series of follow-up studies is described and the limitations of the radioisotope method are discussed. (auth)

48125 SEQUENTIAL SCINTIGRAPHY IN RENAL TRANSPLANTATION. zum Winkel, K.; Harbst, H.; Schenck, P.; Franz, H. E.; Ritz, E.; Roehl, L.; Ziegler, M.; Ammann, W.; Maier-Borst, W. (Institut fuer Nuklearmedizin, Heidelberg). pp 197-208 of Medical Radioisotope Scintigraphy. Vol. II. Vienna, International Atomic Energy Agency, 1969.

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Based on experience gained with more than 1600 patients with proven or suspected kidney diseases and on results on extended studies with dogs, sequential scintigraphy was performed after renal transplantation in dogs. After intravenous injection of 500 μCi ^{131}I-Hippuran scintiphotos were taken during the first minute with an exposure time of 15 sec each and thereafter with an exposure of 2 min up to at least 16 min. Several examinations were evaluated digitally. 26 examinations were performed on 11 dogs with homotransplanted kidneys. Immediately after transplantation, the renal function was almost normal and the bladder was filled in due time. At the beginning of rejection the initial uptake of radioactive Hippuran was reduced. The intrarenal transport became delayed; probably the renal extraction rate decreased. Corresponding to the development of an edema in the transplant the uptake area increased in size. In cases of thrombosis of the main artery there was no evidence of any uptake of radioactivity in the transplant. Similar results were obtained in 41 examinations of 15 persons. Patients with postoperative anuria due to acute tubular necrosis showed still some uptake of radioactivity, contrary to those with thrombosis of the renal artery, where no uptake was found. In cases of rejection, the most frequent signs were a reduced initial uptake and a delayed intrarenal transport of radioactive Hippuran. Infarction could be detected by a reduced uptake in distinct areas of the transplant. (auth)

48126 KIDNEY SCANNING WITH HIPPURAN. A NECESSARY COMPLEMENT FOR CORRECT INTERPRETATION OF RENOGRAPHY IN THE TRANSPLANTED KIDNEY. Lubin, E.; Lewitus, Z.; Rosenfeld, J.; Levi, M. (Univ. of Tel Aviv, Israel). pp 219-23 of Medical Radioisotope Scintigraphy. Vol. II. Vienna, International Atomic Energy Agency, 1969.

From Symposium on Medical Radioisotope Scintigraphy, Salzburg, Austria. See STI/PUB-193(Vol.2); CONF-680804-(Vol.2).

Every impairment of the kidneys' blood supply, and the production or excretion of urine, is reflected by abnormal renograms that are not specific enough in the information they provide. The subsequent performance of renal scans with Hippuran ^{131}I adds information to the topographical distribution of the Hippuran ^{131}I in the renal parenchyma, and to the dynamics of its transport through the urinary system. The information thus obtained is valuable in itself and is necessary for the correct interpretation of renography. It is specially useful in the follow-up of the transplanted kidneys. In cases of anuria following renal transplantation, the renogram is useful for indicating that renal circulation is present in the transplanted kidney but is inadequate as a method to differentiate between other renal and post-renal causes of anuria. The anuric transplanted kidney should be scanned thirty minutes after the injection of Hippuran ^{131}I. Patterns of complementary results of renograms and renal scannings are presented that correspond to prerenal, renal and postrenal causes of anuria. (auth)

48127 RENAL FUNCTION STUDIES WITH A SCINTILLATION CAMERA. Farmelant, M. H.; Genna, S.; Burrows, B. A. (Univ. Hospital, Boston. Boston Veterans Administration Hospital). pp 229-40 of Medical Radioisotope Scintigraphy. Vol. II. Vienna, International Atomic Energy Agency, 1969.

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Renal function studies with ^{131}I-Hippuran have usually been performed with two probes, with flat field collimators, of which the sensitivity is dependent on kidney position. Although a variety of methods were used to interpret the results, it is almost universally agreed that the relative magnitudes of the curves obtained during the accumulation phase are determined by both the relative blood flow and relative geometrical efficiency of counting. The relative influence of these two factors is not easily ascertained. Because of this limitation in directly assessing relative renal blood flow, indirect methods have evolved. From physiological studies in dogs it appears that differences between the kidneys in blood flow produce differences in renal passage time and subsequently differences in the descending portions of the curves. Evaluation of differences in the descending curves in patients has proved highly sensitive in detecting renal vascular disease causing hypertension. However, obstructive disorders of urine outflow also produce alterations in the declining portion of the curve. A scintillation camera provides a detector considerably larger than the kidney and uses parallel hole collimation. This arrangement results in count-rates that are largely independent of kidney position, as shown by phantom studies. Furthermore, sequential scintigraphs can be obtained. Using the Pho-Gamma III (Nuclear Chicago) with split crystal for clinical studies, it was demonstrated that the relative uptake of ^{131}I-hippuran by the two kidneys during the accumulation phase differs by less than 15% in normal people. These differences may be related to differences in kidney size or blood flow. Differences greater than this suggest significant differences between the kidneys in renal blood flow if the scintigrams show kidneys of comparable size. The sequential scintigrams have proven to be accurate in differentiating retention of radioisotope due to vascular disease (retention within the parenchyma) from that due to disease of the drainage system (retention within the kidney pelvis). Consequently the number of studies that falsely suggest renovascular disease was greatly diminished. In a patient with a renal transplant and rapid renal failure the combination of rising renal radioactivity with retention in the kidney pelvis correctly suggested ureteral obstruction rather than tissue rejection or thrombosis of the renal artery. (auth)

48128 USE OF A 10-CHANNEL LINEAR SCANNER IN THE DIFFERENTIAL DIAGNOSIS OF ARTERIAL HYPERTENSION. Cuaron, A.; Ortiz-Quezada, F.; Gordon, F.; Trevino, H.

(Hospital General del Centro Medico Nacional, Mexico City). pp 241-54 of Medical Radioisotope Scintigraphy. Vol. II. Vienna, International Atomic Energy Agency, 1969. (In Spanish).

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A linear scintillation scanner with ten detectors in parallel for delineating lesions was used within the kidney, estimating the rate of renal accumulation of ^{203}Hg-labeled chlormerodrin. Satisfactory renal images were obtained within two or three min after intravenous administration of 100 to 250 mCi of a radioactive drug. Scintigraphic images of both kidneys were obtained at 5, 10, 20, 30, 40, 50, and 60 min after administration of the radioactive compound without suppression of the background radioactivity. All data were recorded on magnetic tape to permit subsequent selection of the technical parameters required for the reproduction of an image of optimum contrast and intensity. The pulse integrator included in the instrument was used to assess radioactivity in both kidneys during each scanning. Results were expressed as the ratio of renal radioactivity at a given time (C_t) to renal radioactivity after five minutes (C_5); this value was called the renal concentration index (RCI). To distinguish bilateral renal ischaemia from essential arterial hypertension, the RCI of the right kidney (RK) was divided by the RCI of the left kidney (LK), which gave a comparative index for the two kidneys. It was concluded that the procedure as described could be used as a selective test for arterial hypertension of renovascular origin, since it furnishes an index directly correlated with the individual renal plasma flow and a series of images representative of the regional blood flow in each of the kidneys. As renal concentration of chlormerodrin requires both good renal blood flow and tubular cell efficiency, in cases of unilateral tubular necrosis results will be obtained similar to those for cases of unilateral renal ischaemia. In the study of arterial hypertension scintigraphic scanning should be carried out in conjunction with the plot of a curve showing renal concentration of chlormerodrin. This is to avoid possible errors due to differences in geometry of the two kidneys in relation to the detector. (auth)

48129 TECHNETIUM-IRON COMPLEX. RADIOPHARMACEUTICAL FOR RENAL SCANNING AND FUNCTION STUDIES. Aquino, J. A.; Cunningham, R. M. (Dalhousie Medical School, Halifax, Nova Scotia. Victoria General Hospital, Halifax, Nova Scotia). pp 255-69 of Medical Radioisotope Scintigraphy. Vol. II. Vienna, International Atomic Energy Agency, 1969.

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A technetium-iron complex as a radiopharmaceutical in the evaluation of kidney function as well as renal scanning is presented. A ^{99m}Tc-iron complex as an agent to determine the kidney function is evaluated. This is correlated with the conventional ^{131}I-Hippuran renogram as well as the mercury accumulative test. The ^{99m}Tc-iron complex as a renal scanning agent is described, and compared with ^{197}Hg-Neohydrin. The availability of the Anger gamma camera, along with ^{99m}Tc and its favorable characteristics have encouraged further search for better preparations. Among these is the ^{99m}Tc-iron complex. Although the pertechnetate ion is not very active chemically in combining with other compounds, it is readily reduced to more reactive lower valence states. Such alterations of chemical form produce changes in biologic localization of ^{99m}Tc. After the intravenous injection of ^{99m}Tc as pertechnetate, it is rapidly localized in the stomach, urinary bladder, thyroid, and salivary glands. Excretion during the first 24 hr occurs largely through the urine. The initial disappearance from the plasma is so rapid that 50% or more has usually left the blood in 3 to 5 min. Part of the ^{99m}Tc is fixed in the kidney which constitutes half of what is retained in the body. The technique consists of obtaining the conventional ^{131}I-Hippuran renogram. This is followed by the injection of ^{99m}Tc-iron complex. The two renograms obtained, using the two agents, are correlated along with other diagnostic tests. Since the ^{99m}Tc-iron complex used for doing the renogram can be used in scanning the kidney, both kidneys are scanned using the Anger gamma camera. Comparative scans are done with the use of ^{197}Hg-Neohydrin. Illustrative pictures are shown. (auth)

48130 CONSECUTIVE RENAL SCANNING WITH ^{131}I AND ^{203}Hg IN OBSTRUCTIVE UROPATHY. Poshyachinda, V. (Chulalongkorn Hospital, Bangkok). pp 271-8 of Medical Radioisotope Scintigraphy. Vol. II. Vienna, International Atomic Energy Agency, 1969.

From Symposium on Medical Radioisotope Scintigraphy, Salzburg, Austria. See STI/PUB-193(Vol.2); CONF-680804-(Vol.2).

Two patients with obstructive uropathy were scanned after injection of ^{131}I sodium orthoiodohippurate (OIH) and ^{203}Hg chlormerodrin. The ^{131}I OIH scan was performed 30 min after the injection with the patient in a prone position. The ^{203}Hg chlormerodrin was injected as soon as a negligible amount of ^{131}I OIH was detected over the kidney, and the patient was scanned again 30 min later. A third patient and a normal subject were scanned 20 min after the simultaneous injection of ^{131}I OIH and ^{203}Hg chlormerodrin. Three scans with different analyzer settings were done in sequence. The first scan was done with a window setting for ^{131}I, and the second scan included both ^{131}I and ^{203}Hg; in the third scan, the analyzer was set for ^{203}Hg only. Evidence of hydronephroses, hydroureter, and the residual functioning renal tissue were demonstrated by this scanning technique. The intravenous pyelograms in all three cases had failed to give satisfactory results. The simultaneous injection technique proved to be better than the separate injection technique. (auth)

48131 SCINTIGRAPHY OF THE JOINTS. Roucayrol, J.-C.; Delbarre, F.; Ingrand, J.; Aignan, M. (Hopital Cochin, Paris). pp 281-94 of Medical Radioisotope Scintigraphy. Vol. II. Vienna, International Atomic Energy Agency, 1969. (In French).

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More than 200 cases of synovitis of different aetiology were treated by intra-articular injection of colloidal suspensions of ^{198}Au and ^{90}Y. To study the distribution of each isotope, control scintigrams were taken in at least two positions in the majority of cases. The results obtained explained certain therapeutic failures. Images of normal and pathological articular cavities were obtained after injection of a colloid prepared by the Radicella technique. The results of joint scintigraphy with ^{99m}Tc are compared with those of conventional arthrography carried out using water-soluble iodine compounds; radiation dosage received by the gonads, insofar as this was measured using a thermoluminescent dosimeter, is compared for ^{99m}Tc and ^{131}I. (auth)

48132 SCINTIGRAPHY BY MEANS OF RADIOISOTOPES OF SHORT HALF-LIFE FOR DIAGNOSING DISEASES OF THE JOINTS. Martinez-Villasenor, D. (Comision Nacional de Energia Nuclear, Mexico City); Bush, Dra. P.; Katona, G. pp 295-305 of Medical Radioisotope Scintigraphy. Vol. II. Vienna, International Atomic Energy Agency, 1969. (In Spanish).

From Symposium on Medical Radioisotope Scintigraphy, Salzburg, Austria. See STI/PUB-193(Vol.2); CONF-680804-(Vol.2).

Persons suffering from articular diseases exhibit an increase in vascularization associated with a concomitant inflammatory process. This hyper-vascularization can be visualized in cases of rheumatoid arthritis by means of radiotracer scanning of the vascular compartment. Results of a study of 107 persons suffering from various articular conditions are presented. The study was based on radioisotope scanning with ^{99m}Tc and ^{113m}In. A commercial apparatus with a 5-in. crystal and an 85-hole focused collimator was used. They applied 6 to 10 mCi of ^{99m}Tc in the form of sodium pertechnetate and 8 to 10 mCi as indium chloride (adjusted to pH 3.5), both administered intravenously at 24-hr intervals. Different scintigraphic images were observed for each of the radioisotopes, the degree of concentration not being identical for a given joint. The procedure was useful for the early diagnosis of articular lesions and in some cases for carrying out differential diagnosis. It is also indicated that the increase in vascular permeability would afford the most satisfactory explanation for the increased radioactivity in the joints when ^{99m}Tc is used as pertechnetate, even though other factors might exist apart from the increase in vascularization, which was not satisfactorily shown when ^{113m}In was used. (auth)

48133 DETECTION OF ARTHRITIS BY JOINT SCANNING. Maxfield, W. S.; Weiss, T. E.; Tutton, R. H.; Hidalgo, J. U. (Ochsner Clinic and Ochsner Foundation Hospital, New Orleans). pp 307-23 of Medical Radioisotope Scintigraphy. Vol. II. Vienna, International Atomic Energy Agency, 1969.

From Symposium on Medical Radioisotope Scintigraphy, Salzburg, Austria. See STI/PUB-193(Vol.2); CONF-680804-(Vol.2).

Detection and identification of early arthritis is frequently difficult with routine methods. Several tracers, ^{131}I human serum albumin (25 μCi/10 lb), ^{99m}Tc human serum albumin (1 to 3 mCi), ^{131}I iodipamide (40 μCi/10 lb), and ^{99m}Tc pertechnetate (10 mCi), were used for joint scanning to detect synovitis produced by arthritis in joints of the extremities. When administered intravenously, the 25% increase in localization of these tracers in the synovial membrane, if there is active synovitis, can be demonstrated by scintillation scanning. This ability to detect synovitis at an early stage enables the joint scan to show areas of active synovitis not demonstrated on roentgenograms. The scan may objectively confirm or disprove questionable physical findings. This technique was useful in determining whether joint pain is functional or due to arthritis as a negative localization tends to rule out active synovitis as the cause of the pain. The scan demon-

stration of a positive localization of the tracer in several joints when only one area is symptomatic is evidence that joint pain is due to systemic disease. The short half-life tracers permit serial studies to follow the course of an arthritis process. Use of ^{99m}Tc pertechnetate and an Anger camera made joint scanning a practical technique for clinical use. A review of the accuracy of joint scanning in 130 cases as compared to roentgenograms is presented. (auth)

48134 BONE SCINTIGRAPHY WITH ^{18}F AND ^{87m}Sr. Scheer, K. E.; Harbst, H.; Kampmann, H.; zum Winkel, K.; Maier-Borst, W.; Lorenz, W. J.; Bilaniuk, L. (Institut fuer Nuklearmedizin, Heidelberg). pp 325-39 of Medical Radioisotope Scintigraphy. Vol. II. Vienna, International Atomic Energy Agency, 1969.

From Symposium on Medical Radioisotope Scintigraphy, Salzburg, Austria. See STI/PUB-193(Vol.2); CONF-680804-(Vol.2).

A group of patients with various bone lesions was investigated using ^{18}F and ^{87m}Sr. The lesions included primary bone tumors, metastases, fractures, and various bone diseases. The examinations were performed using scanners and the Bender and Blau Digital Autofluoroscope. The radionuclides ^{18}F and ^{87m}Sr were produced in the TRIGA Mark I reactor at the German Cancer Research Center at Heidelberg. The ^{18}F was obtained by irradiation of Li_2CO_3 enriched in ^6Li to 95%. The reaction took place in two steps, namely: $^6Li(n,t)^4He$ and $^{16}O(t,n)^{18}F$. The ^{87m}Sr was obtained from $Sr(NO_3)_2$ enriched in ^{86}Sr to 97.6%. The amount of ^{84}Sr in the irradiated sample was less than 0.05% and that of ^{88}Sr less than 1.73%. Carrier-free ^{18}F in a physiologic saline was injected intravenously before each examination. Usually 2 mCi were used in a volume of 1.4 ml. Tritium contamination did not exceed 2 μCi. The ^{87m}Sr was also injected carrier free in an amount of 3 mCi dissolved in 0.7 ml of water. The radionuclide impurities contained in this amount were not more than 1 nCi ^{85}Sr and 10 nCi ^{89}Sr. The scintigraphy was performed half an hour after the injection of ^{18}F and one hour after the injection of ^{87m}Sr. Bone examination with ^{18}F and ^{87m}Sr was made to search for metastases to check radiotherapeutical results and to determine the existence and/or extension of bone destruction when other examinations were not conclusive. To facilitate detection of metastases a profile of the activity uptake of the whole body was recorded. Bone scintigraphy allows localization of bone regions with higher mineral metabolic activity. Differences between the uptake of ^{18}F and ^{87m}Sr were not observed. Scintigraphy with ^{18}F and ^{87m}Sr is a very useful complement to the roentgenologic and clinical diagnosis of bone diseases. (auth)

48135 ISOTOPE SCANNING WITH ^{18}F FOR THE EARLY DETECTION OF BONE TUMORS. Blau, M.; Laor, Y.; Bender, M. A. (Roswell Park Memorial Inst., Buffalo). pp 341-7 of Medical Radioisotope Scintigraphy. Vol. II. Vienna, International Atomic Energy Agency, 1969.

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The metabolic processes leading to bone deficits or accretions go on for a substantial period before an appreciable change in bone density can be seen on roentgenograms. Since isotope localization is a function of these metabolic processes, early visualization of bone tumors can be achieved by scanning. The mechanism of uptake of the isotope in osteolytic or osteoblastic lesions is by ion exchange with exposed bone crystals. Any small ion which can take the place of Ca^{2+}, OH^-, or PO_4^{3-} in bone salt will localize. The γ-ray energy of ^{47}Ca (1.3 MeV) is too high for use with scanning equipment found in most hospitals, and the half-life of ^{85}Sr (65 days) prevents the administration of adequate doses of this isotope. The ^{18}F fluoride ion is rapidly taken up in bone lesions and the non-localized isotope is quickly cleared from the blood and soft tissue. The short physical half-life of ^{18}F permits the use of large doses with little radiation to the patient. Over 350 patients have been studied. Lesions visible on roentgenograms have almost invariably shown abnormal uptake of the isotope. In over 10% of the cases it was possible to demonstrate bone metastases on the isotope scans before x-ray changes appeared. (auth)

48136 EARLY DETECTION OF BONE LESIONS BY PHOTOSCANNING WITH RADIOACTIVE ^{87m}Sr. Kostamis, P.; Constantinides, C.; Papavasiliou, C.; Binopoulos, D.; Sfontouris, J.; Malamos, B. (Univ. of Athens. Alexandra Hospital, Athens). pp 349-64 of Medical Radioisotope Scintigraphy. Vol. II. Vienna, International Atomic Energy Agency, 1969.

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Patients with proven and suspected bone lesions were scanned from 30 min to 3 hr after an intravenous injection of 400 μCi to 1 mCi of ^{87m}Sr. Many different types of bone tumors were detected, such as osteogenic sarcoma and metastatic cancer of breast, thyroid, lung, and other organs. Strontium-87m photoscanning easily demonstrates obvious tumors of the bone that were visualized on the roentgenogram, but the most important purpose of the present study is the visualization of lesions that were not demonstrated on the conventional roentgenogram. (auth)

48137 AXIAL SKELETAL SCINTIGRAPHY IN CANCER OF THE BREAST. Galasko, C. S. B. (Royal Postgraduate Medical School, London. Hammersmith Hospital, London). pp 367-77 of Medical Radioisotope Scintigraphy. Vol. II. Vienna, International Atomic Energy Agency, 1969.

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An initial study was made on eight patients shown to have osseous metastases on x ray. Each patient was examined on two occasions after the injection of ^{87m}Sr and ^{18}F. Regions known to contain metastases were examined at regular intervals after each injection. The scintigrams were compared with x-ray skeletal surveys. In all patients the ^{18}F scintigram gave better results than the ^{87m}Sr scan. All metastases present on x ray were detected with the γ camera and in six patients the scintigram revealed additional lesions. The optimum times for scanning were 1¼ to 3 hr after injection of ^{18}F and 3 to 4½ hr after ^{87m}Sr. The technique of axial skeleton scanning with the γ camera and ^{18}F, and the results obtained in over 60 patients with cancer of the breast, are reported. (auth)

48138 THE PRESENT STATUS OF SPLEEN SCINTIGRAPHY: CLINICAL RESULTS OBTAINED IN 4500 CASES. Fischer, J.; Leon, A.; Wolf, R. (Univ., Mainz). pp 381-99 of Medical Radioisotope Scintigraphy. Vol. II. Vienna, International Atomic Energy Agency, 1969. (In French).

From Symposium on Medical Radioisotope Scintigraphy, Salzburg, Austria. See STI/PUB-193(Vol.2); CONF-680804-(Vol.2).

As compared with scintigraphic studies of other parenchymatous organs, such as the thyroid, the liver and the kidneys, study of the spleen was until recently somewhat neglected. This is all the more surprising since, apart from angiographic techniques, there is no simple radiographic method of obtaining the true image of this organ. The biological principle of spleen scanning is based on the spleen's biological property of eliminating from the blood those red blood corpuscles which have lost their plasticity. This loss of plasticity can be brought about artificially by physical or chemical alteration of the corpuscles, which after injection are rapidly removed from the blood and accumulate in the spleen. The rate of blood clearance and selectivity of the accumulation process in the spleen differ from one method to the next. Techniques for the labeling and alteration of red corpuscles for the purposes of scanning are reported, some of these methods giving a very exact image of the spleen. By using planimetry, one can easily estimate the area of the scintigram and determine the volume of the organ. One can thus, for the first time, make an exact and quantitative estimate of the degree of any splenomegaly present, thereby obtaining information of great value in general medicine. Comparison of clinical and scanning diagnoses in more than 3,000 cases showed that only 26% of the cases of splenomegaly could be detected clinically. Results obtained by means of spleen scanning in connection with haematological and hepatic diseases are presented. (auth)

48139 SPLEEN SCINTIGRAPHY IN HODGKIN'S DISEASE. Gongora, R. (Fondation Curie, Paris); Gongora, G.; Jammet, H.; Bilski-Pasquier, G.; Bousser, J. pp 401-17 of Medical Radioisotope Scintigraphy. Vol. II. Vienna, International Atomic Energy Agency, 1969. (In French).

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Results of scintigraphic studies carried out on patients suffering from Hodgkin's disease are reported. Technical details of the study are given, stressing the need for rigorous procedures in corpuscle labeling and alteration, and also the importance of collimation and of scanning at different angles of incidence; different morphological characteristics encountered in scanning are described, in particular, dimensional and structural attributes of the image; homogeneous and diffuse heterogeneous structures and also heterogeneous structures with gaps are evaluated. The changes in the scanning image during treatment are also described and the value of the scintigraphic method for checking on the development of splenic symptoms in the course of the disease is stressed. Data obtained from analysis of blood and spleen radiation curves and details on the findings of spleen scintigraphy are discussed. (auth)

48140 SCINTIGRAPHY IN THE DIAGNOSIS AND TREATMENT OF MALIGNANT LYMPHOMAS. McCready, V. R.; Gwyther, M. M.; Stringer, A. M. (Inst. of Cancer Research, Sutton, Eng. Royal Marsden Hospital, Sutton, Eng.). pp 419-30 of Medical

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From Symposium on Medical Radioisotope Scintigraphy, Salzburg, Austria. See STI/PUB-193(Vol.2); CONF-680804-(Vol.2).

Although radioisotope techniques are widely used for tumor diagnosis, little attention has been paid to their use in the diagnosis of the lymphomata. The use of scanning techniques in Hodgkins disease is described. Liver scans were useful in determining more accurately the size and position of the liver and, occasionally, in finding actual localized involvement. Diffuse disease posed particular difficulties but diagnosis was often possible by the use of serial scans when there was an alteration in size or pattern of uptake of colloid. Spleen scans were mainly useful in determining the exact size of the organ. Actual tumor involvement was rarely seen. Attempts at assessing early involvement by noting uptake of colloid, or the rate of uptake of denatured red cells, were made. (auth)

48141 VISCERAL PERFUSION SCINTIGRAPHY WITH ^{131}I-LABELED ALBUMIN MACROAGGREGATES. Ueda, H.; Yamada, H.; Kitani, K.; Nagatani, M.; Takeda, T.; Migita, T.; Iio, M.; Kameda, H. (Tokyo Univ.). pp 431-45 of Medical Radioisotope Scintigraphy. Vol. II. Vienna, International Atomic Energy Agency, 1969.

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Iodine-131-labeled albumin macroaggregates were injected into the celiac artery. Subsequent scanning revealed the following: blood flow was increased in the hepatic artery in liver cirrhosis, while it was increased in the splenic artery in non-cirrhotic portal hypertension. With this method, malignant neoplasms of the liver appeared as hot spots; whereas, after direct injection of the radioisotope into the spleen, liver tumors appeared as cold spots. Therefore, neoplastic hepatic lesions are predominantly supplied by the hepatic artery rather than by the portal vein. Following celiac injection, liver cysts appeared as cold spots and could be clearly differentiated from neoplasms. Arterio-venus shunts were diagnosed by the appearance of the radioisotope in the lung. (H.B.G.)

48142 VISUALIZATION OF ABDOMINAL ORGANS BY INTRA-ARTERIAL INJECTION OF ^{131}I-LABELED ALBUMIN MACROAGGREGATES. Ogris, E.; Hoefer, R.; Depisch, D.; Pokieser, H.; Grabner, G.; Brunner, H. (2nd Medical Univ. Clinic, Vienna. Surgical Univ. Clinic, Vienna). pp 447-58 of Medical Radioisotope Scintigraphy. Vol. II. Vienna, International Atomic Energy Agency, 1969.

From Symposium on Medical Radioisotope Scintigraphy, Salzburg, Austria. See STI/PUB-193(Vol.2); CONF-680804-(Vol.2).

Perfusion scintigrams of the abdominal organs were made after intra-arterial injection of ^{131}I-MAA through the lying catheter immediately after angiographic examination of the coeliac and superior mesenteric artery vascular system. The anatomical architecture of the coeliac artery makes it impossible to visualize a single organ by scanning with this technique because several organs get their blood supply from the branches of this artery. Interpretation of a perfusion scintigram alone is therefore impossible. For better interpretation some simple methods were developed: selective catheterization techniques; supplementation of the perfusion scintigram by a subsequent scintigram that delineates a single organ, like liver, by means of colloidal radiogold; and photographic superposition of one scintigram over another to give a clear identification of the individual organs, especially the pancreatic head, by subtraction of the optic density. Mostly patients suspected of pancreatic carcinoma were studied. The results correlated well with those of other methods, especially coeliac arteriography, and were partly confirmed by surgical intervention. Thus, perfusion scintigraphy of the abdominal organs seems to be a useful complement to coeliac arteriography in diagnosing pancreatic diseases. (auth)

48143 SCINTIGRAPHY OF THE LIVER, LUNGS, SPLEEN, KIDNEYS, BRAIN, HEART, AND BONES IN THE DIAGNOSIS OF HYDATID CYSTS. Touya, J. J. Jr.; Osorio, A.; Touya, E. F.; Bekerman, C.; Paez, A.; Ferrari, M. (Faculty of Medicine, Montevideo). pp 459-87 of Medical Radioisotope Scintigraphy. Vol. II. Vienna, International Atomic Energy Agency, 1969.

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The results of scintigraphic studies in a group of 320 patients with hydatid disease (HD) were analyzed. Of these, 291 cases had HD of the liver, 9 HD of the lungs, 6 HD of the spleen, 2 HD of the kidneys, 5 HD of the brain, 5 HD of the heart, and 3 HD of the bones. A moving detector device and a stationary detector device were used. It was found that in the HD of the liver both detector devices have a very similar effectiveness in the detection of cysts. In endemic areas, the stationary detector device is more advantageous than the moving detector as it demands less time for each examination, enables scintigraphs in conjunction with apnea and facilitates studies of children. Indium-113m proved closest to the ideal for studying HD in whatever organ. (auth)

48144 DIAGNOSIS BY LIVER SCINTIGRAPHY. Zubovskii, G. (Scientific-Research Roentgen-Radiology Inst., Moscow). pp 491-506 of Medical Radioisotope Scintigraphy. Vol. II. Vienna, International Atomic Energy Agency, 1969. (In Russian).

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One hundred and two patients were subjected to both scintigraphy and contrast x-ray investigation of the liver. Five hundred conditions were ascribed to localized liver infections (fibroses, cysts and tumors) and the remaining 700 to diffuse infections (cirrhosis, hepatitis, systemic blood diseases, etc.). On the basis of analysis of scintigrams from 1200 patients with definitively established liver conditions criteria were drawn up for use in diagnosis by liver scintigraphy, on the lines of those employed in the practice of x-ray diagnosis. It was found that, depending on the type of pathological process and its distribution characteristic, changes were observed in the liver scintigram. The changes observed in a liver scintigram in cases of disease of the surrounding organs, such as the lungs, diaphragm, pancreas and certain others, were also determined. On the basis of detailed analysis of 88 scintigrams from patients showing no signs of liver infection, the author evolved the concept of a normal scintigraphic representation of the liver, dependent on the constitutional characteristics of the individual. A thorough knowledge of the underlying principles of liver scintigraphy makes it possible to improve the diagnostic efficacy of the scanning process for various liver diseases. (auth)

48145 SCINTILLATION CAMERA AND 1600-CHANNEL ANALYSER FOR THE DIAGNOSIS OF METASTATIC CANCER OF THE LIVER. Jasinski, W. K.; Malinowska, J.; Mackiewicz, H.; Siwicki, H.; Tolwinski, J. (Inst. of Oncology, Warsaw). pp 507-16 of Medical Radioisotope Scintigraphy. Vol. II. Vienna, International Atomic Energy Agency, 1969.

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A series of 59 consecutive cases of histologically proven breast cancer cases were admitted for radiotherapy. The group was mostly composed of stage III/TNM. The patients were studied with a scintillation camera and a 1600-channel analyser after iv injection of 2 mCi of colloidal ^{99m}Tc. Up to 10^4 counts were accumulated in one of the elements of the analyzer matrix and were then transferred to computer-compatible punched tape. The data could be presented immediately in a number of different ways: as conventional scintigraphic pictures on the camera's oscilloscope; as nine pictures from the analyzer's oscilloscope with 10, 20, 30, ... 90% of the counts erased; and as one picture with those four selected levels of erase that were considered best, for a given case. In addition, progressive increase of exposure and defocusing of each level was possible. Examination with colloidal ^{99m}Tc was found to be a safe method for the detection of malignant secondaries in the liver because of the low irradiation dose to the patient. The high radioactivity accumulated in the liver means a short examination time and the elimination of statistical fluctuations. Furthermore, the stored information enables the time-consuming work to be done in the patient's absence. (auth)

48146 INTERPRETATION OF SCINTIGRAPHIC CHANGES DURING CHRONIC HEPATITIS AND CIRRHOSIS OF THE LIVER. Gheorghescu, B.; Jovin, G.; Pavel, D.; Hoanca, O.; Marculescu, Lidia; Suseanu, I.; Sparchez, T. (Center of Gastroenterology, Bucharest). pp 517-32 of Medical Radioisotope Scintigraphy. Vol. II. Vienna, International Atomic Energy Agency, 1969.

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Photoscintigrams in black and white and in color were made of the liver and the hepatic clearance was determined by colloidal ^{198}Au (dimensions 25 to 30 μm) in 82 patients suffering from chronic hepatitis or cirrhosis confirmed by clinical, humeral and histological criteria. The most characteristic changes in the liver scintigram, found particularly in the cirrhosis patients, were: atrophy of the right lobe (partial or total), sometimes pseudotumoral in appearance; pale or inhomogeneous left lobe; presence of two centers of maximum radiocolloid uptake (left lobe and right lobe); and extrahepatic fixation (spleen, bone marrow). The color recording system provided better information than the monochromatic system in the diagnosis of cirrhosis. Hepatic clearance showed a decrease, especially in cases of cirrhosis characterized by extrahepatic uptake of the radiocolloid. In the opinion of the authors, the height of the radioactivity curve registered in the temporal region is an indication, during the stabilization phase,

of extrahepatic fixation of the colloidal gold. Its height (h_2) is greater in those cases where the scintigram indicated higher uptake in the spleen and bone marrow. The $T_{\frac{1}{2}}$ study of ^{51}Cr-labeled erythrocytes and their sequestration in the spleen was made in 30 patients exhibiting increased extrahepatic uptake of colloid gold. The sequestration of labeled erythrocytes was observed in patients showing large-scale splenic uptake of the radiocolloid. Some of the patients whose photoscintigrams previously showed atrophy of the lower region of the right lobe of the liver and obvious presence of the spleen received injections of colloidal gold in the spleen. After intrasplenic injection, the same scintigraphic image in cirrhosis patients was obtained, with persistence of the colloidal gold in the spleen, whereas the image of the spleen remained normal in normal subjects. This proves the existence of a lamellar circulation in the liver. The splenic blood in normal subjects was directed towards the right lobe of the liver. The existence of anomalies in hepatic circulation and also of hyperactivity of the extrahepatic reticulo-endothelial system, especially of the spleen, is indicated. These two elements may explain the anomalies in the distribution of colloidal gold in chronic liver patients. This change is most pronounced in cirrhosis of the liver. (auth)

48147 COMPARISON OF ^{99m}Tc SCINTIGRAPHY WITH ULTRASONIC SCANNING IN THE DETECTION OF LIVER DISEASE. Davies, E. R.; McCarthy, C. F.; Wells, P. N. T.; Ross, F. G. M.; Read, A. E.; Follett, D. H.; Muir, K. M. (United Bristol Hospitals, Eng. Univ. of Bristol, Eng.). pp 533-44 of Medical Radioisotope Scintigraphy. Vol. II. Vienna, International Atomic Energy Agency, 1969.

From Symposium on Medical Radioisotope Scintigraphy, Salzburg, Austria. See STI/PUB-193(Vol.2); CONF-680804-(Vol.2).

Both radioisotope scintigraphy and ultrasonic scanning of the liver are valuable techniques in the diagnosis of liver disease. Technetium-99 was used for liver scintigraphy. The relative contribution of these two methods to an accurate diagnosis was compared in normal patients and in patients with cirrhosis of the liver, liver metastases, hepatoma, liver abscess, cysts of the liver, etc. Over 500 patients were examined by either the ultrasonic technique or the scintigraphic technique, and 100 patients were examined by both techniques. Certain characteristic appearances were recognized readily and each method separately detected liver abnormality in approximately 85% of instances. When both techniques were applied to the same patient the diagnostic accuracy increased appreciably. Radioisotope scintigraphy often gave a more definite picture of liver metastases when the ultrasonic scan was only suggestive of them. Liver abscesses and cysts appeared on the scintigraph as filling defects that were indistinguishable from metastases; but on the ultrasonic scan these lesions were clearly fluid filled. Cirrhosis was diagnosed equally well by both techniques. Ultrasonic scanning was more accurate in detecting some diffuse abnormalities, and scintigraphy gave information not otherwise available about the size and shape of the liver and spleen. The value and limitations of the two methods are described. (auth)

48148 A MEANS FOR THE SCINTIGRAPHIC IMAGING OF REGIONAL BRAIN DYNAMICS. REGIONAL CEREBRAL BLOOD FLOW AND REGIONAL CEREBRAL BLOOD VOLUME. Potchen, E. J.; Bentley, R.; Gerth, W.; Hill, R. L.; Davis, D. O. (Washington Univ., St. Louis). Contracts NIH 1P07 FR00396-01; NIH 5 PO1 NBOb833-02; AT(11-1)-1653. pp 577-83 of Medical Radioisotope Scintigraphy. Vol. II. Vienna, International Atomic Energy Agency, 1969. (COO-1653-46).

From Symposium on Medical Radioisotope Scintigraphy, Salzburg, Austria. See STI/PUB-193(Vol.2); CONF-680804-(Vol.2).

The use of freely diffusable inert radioactive gas as a washout indicator to measure regional cerebral blood flow has become a standardized kinetic procedure in many laboratories. Regional flow with perfusion against regional flow without perfusion from the early portion of the curve is distinguished. Based on a detailed study of the early curve kinetics in patients with and without cerebral vascular disease, the sampling duration necessary for application of the Anger gamma camera imaging process to regional changes in cerebral radioactivity was defined. Using a standard camera and a small computer, a procedure was developed and based upon entire field to determine the time of maximum height followed by analysis of the data in a matrix. This will permit a contour plot presentation of calculated regional cerebral blood flow in millilitres per 100 grams perfused brain per minute. Preliminary investigation on sampling duration, and Compton scattering were prerequisite to clinical scintigraphy of regional cerebral blood flow. In addition, the method of interface for the conventional Anger gamma camera to digital computers used in this procedure is discussed. (auth)

48149 CEREBRAL SCINTIGRAPHY IN THE CHILD AND NURSING INFANT. Akerman, M.; Rougerie, J.; Guiot, G. (Hopital Foch, Suresnes, France). pp 585-604 of Medical Radioisotope Scintigraphy. Vol. II. Vienna, International Atomic Energy Agency, 1969. (In French).

From Symposium on Medical Radioisotope Scintigraphy, Salzburg, Austria. See STI/PUB-193(Vol.2); CONF-680804-(Vol.2).

Throughout a period of 5 yrs, 400 children, ranging in age from two months to 16 yrs, were examined with radioisotope brain scans. RISA was used initially and then replaced by ^{197}Hg-neohydrin and, finally, by ^{99m}Tc. Overall, results of cerebral scintigraphy were less favorable in children as compared to adults because of the high incidents of tumors involving the brain stem, the pituitary, and the third ventricle, that were difficult to detect. However, good results were obtained in the case of 35 tumors of the cerebellum and of the fourth ventricle. In addition, excellent results were obtained in chronic subdural hematomas and vascular malformations. (H.B.G.)

48150 SCINTIGRAPHY OF THE PERICEREBRAL SUBARACHNOID SPACES. Oberson, R.; Martini, T. (Hopital Cantonal, Lausanne, Switzerland). pp 605-25 of Medical Radioisotope Scintigraphy. Vol. II. Vienna, International Atomic Energy Agency, 1969. (In French).

From Symposium on Medical Radioisotope Scintigraphy, Salzburg, Austria. See STI/PUB-193(Vol.2); CONF-680804-(Vol.2).

In more than 100 patients, RISA was injected into the subarachnoid space. From subsequent brain scans, normal values were elicited and pathologic deviations were established. Valuable information about the hydrodynamics of the cerebrospinal fluid was obtained, especially for the diagnosis of hydrocephalus, fistulas, and cysterno-ventricular reflux. (H.B.G.)

48151 BRAIN TUMOR SCINTIGRAPHY WITH ^{99m}Tc-PERTECHNETATE, ^{99m}Tc-Fe(II) COMPLEX AND ^{131}I-LABELED MACROAGGREGATED ALBUMIN. COMPARISON OF RESULTS. Haas, J. P.; Dietz, H.; Schmidt, K. J.; Doerr, F.; Brod, K. H.; Wolf, R. (Univ., Mainz). pp 627-55 of Medical Radioisotope Scintigraphy. Vol. II. Vienna, International Atomic Energy Agency, 1969. (In French).

From Symposium on Medical Radioisotope Scintigraphy, Salzburg, Austria. See STI/PUB-193(Vol.2); CONF-680804-(Vol.2).

Technetium-99m, in the form of pertechnetate, has gained its place in brain scintigraphy. The diagnostic value is equal that of substances labeled with mercury or iodine. Intraarterial introduction of macroaggregated albumin; and intravenous injection of a new substance, the ^{99m}Tc-Fe(II) complex, were used in addition to ^{99m}Tc-pertechnetate. Experiments were carried out on over 100 patients with brain tumors. Compared with scintigraphy involving intravenous injection of ^{99m}Tc-pertechnetate, this new method gives supplementary information that is often of considerable help in clinical neuroradiological diagnosis of these patients. The findings in a majority of cases were confirmed by operation or by autopsy. The method made it possible for the first time to use scintigraphy to visualize the arterial network of the brain. ^{99m}Tc-Fe(II) was used in the detection of brain tumors. The first results showed it to be incontestably superior to all others previously applied intravenously. It has the advantages of ^{99m}Tc as regards the irradiation dose to the patient and gives an exceptionally precise delineation of the invasive cerebral processes due to a rapid fall in blood concentration. A combination of these two new scintigraphic methods opens up new possibilities and greatly enhances the field of application of radioisotopes in the clinical study of brain diseases. (auth)

48152 SCINTIGRAPHY OF THE PLACENTA WITH ^{113m}In. Lewitus, Z.; Lubin, E.; Rechnic, J.; Laor, J.; Eckerling, E. (Univ. of Tel Aviv, Israel). pp 657-64 of Medical Radioisotope Scintigraphy. Vol. II. Vienna, International Atomic Energy Agency, 1969.

From Symposium on Medical Radioisotope Scintigraphy, Salzburg, Austria. See STI/PUB-193(Vol.2); CONF-680804-(Vol.2).

Indium-113m is used in scintigraphic placental localization. The ^{113m}In, generated from a commercial ^{113}Sn cow, eluted with 0.05N HCl, stabilized with gelatin at pH 4.0, and autoclaved in the carrier-free form, becomes bound to the plasma proteins after being injected intravenously and stays in the vascular system long enough to enable scanning of the placental blood pools. The short physical half-life and the decay by isomeric transition reduces the radiation dose compared with other scanning agents. The minimal elimination of the molecule into the bladder during scanning has the advantage over the use of ^{99m}Tc because it diminishes the possible confusion of activity in this area with a low-lying placenta. The placentography was found of value in the diagnosis of placenta praevia, twins, and hydatidiform mole. (auth)

48153 A THEORETICAL AND EXPERIMENTAL STUDY OF THE SUBTRACTION OF TWO SCINTIGRAPHIC IMAGES. AS

APPLIED TO VISUALIZATION OF THE PANCREAS. Desgrez, A.; Razafindramamba, V.; de Saint-Laurent, J.; Kellershohn, C. (Service Hospitalier Frederic Joliot, Orsay, France). pp 677-94 of Medical Radioisotope Scintigraphy. Vol. II. Vienna, International Atomic Energy Agency, 1969. (In French).

Scintigraphy of the pancreas is impeded by localization of selenomethionine in the liver. Similarly, certain types of liver incorporation impair the visualization of insufficiency in the right kidney. One solution to this problem is to use two different labeled compounds to produce two images and then subtract one from the other so as to separate the tissue to be depicted. Various problems involved in subtraction are investigated. For example, exact spatial coincidence of the data to be subtracted can be ensured only by simultaneous recording of the two images; a consecutive recording, even if it is fast, may be detrimental. The operation often consists in a double technique: suppression of the unwanted tissue by subtraction and amplification of the contrast between the tissue under investigation and residual background noise. These two methods, subtraction and amplification, relate to variable magnitudes; the resolution of the final image is thus a function of certain statistical parameters, that are discussed. In studies carried out on the pancreas, attention is paid to the respective advantages and conditions of spectrometric separation of the various products that can be used for subtraction; the value of labeled rose bengal, that can also be used for eliminating certain intestinal loops, is stressed. A description is given of two types of apparatus that can be used in making the subtraction. The first and cheaper device involves storing the data obtained on four-track magnetic tape; the second and more rapid method utilizes the memory of a 4096-channel analyzer. With both of these devices it is possible to make several subtractions during a single examination and the fraction of the quantity to be subtracted can be varied. (auth)

48154 COMPARISON OF SCINTIGRAPHIC AND RADIOLOGICAL RESULTS IN THE DIAGNOSIS OF PANCREATIC DISEASES. Deininger, H. K.; Sielaff, H. J. (Staedtische Krankenanstalte, Heilbronn, Ger.). pp 695-706 of Medical Radioisotope Scintigraphy. Vol. II. Vienna, International Atomic Energy Agency, 1969.

From Symposium on Medical Radioisotope Scintigraphy, Salzburg, Austria. See STI/PUB-193(Vol.2); CONF-680804-(Vol.2).

The results obtained by pancreas scanning and standard radiological diagnostic methods are compared. The roetgenographic examinations of the stomach, intestine, colon, biliary tract, and kidneys were performed by standary x ray methods and by abdominal tomography with pneumoretroperitoneum. Special methods of a radiological pancreatic diagnosis, e.g., selective angiography and intra-operative pancreatography, are not considered. One hundred and ninety two pancreas scans were carried out after administration of ^{75}Se-l-selenomethionine. The patients were prepared either with a special diet or a fasting period. The quality of the pancreas scans depended on the functional state of the pancreatic tissue and a comparison with phantom studies allowed an approximate estimation of the extent of the parenchymatous lesions. Of the 87 cases with proven pancreatic diseases the results were compared with the scintigraphical and radiological findings. This comparative research illustrates the superiority of pancreas scanning over the conventional roetgenographic methods in the exclusion or detection of pancreatic diseases. (auth)

48155 IMPORTANCE AND LIMITATIONS OF SCINTIGRAPHY OF THE PANCREAS: RESULTS OF 200 EXAMINATIONS INVOLVING ELECTRONIC SUBTRACTION OF THE IMAGE OF THE LIVER. Blanquet, P.; Beck, C.; Pigneux, J.; Hecquet, M. F. (Hopital Saint-Andre, Bordeaux). pp 707-19 of Medical Radioisotope Scintigraphy. Vol. II. Vienna, International Atomic Energy Agency, 1969. (In French).

From Symposium on Medical Radioisotope Scintigraphy, Salzburg, Austria. See STI/PUB-193(Vol.2); CONF-680804-(Vol.2).

In the course of routine hospital practice, 200 scintigraphic scans of the pancreas with suppression of the image of the liver were carried out. The examinations were made with an Anger camera, used in conjunction with the integrating memory of a 4096-channel pulse analyzer. With this arrangement it was possible to subtract the data provided by heavy colloids of ^{198}Au taken up by the liver from data relating to ^{75}Se-labeled selenomethionine incorporated by the liver or the pancreas. The technique used is simple and requires immobilization of the patient for about one hour. Its purpose is to give an image of the pancreas free from any superimposed image of the liver and also to provide information on the rate at which the labeled compound is stored in the gland. The dose absorbed by the pancreas is minimal, owing to the short length of time that the radioisotope remains within the gland. The dose received by the whole body is not negligible and therefore the number of examinations made on subjects with a clinically normal pancreas was limited to five. Although its principle is open to criticism, the subtraction technique gave completely satisfactory results in practice. Suppression of the liver image was not always complete but in all cases the image of the pancreas was sufficiently isolated to allow interpretation of it as a whole. It should, however, be noted that the zone of projection common to the two organs is often somewhat inhomogenous after subtraction has been effected. In subjects free from pancreatic disorders, the scintigram was in all cases normal. In the cases of confirmed chronic pancreatitis the picture is unequivocal. The tumors can manifest themselves in a variety of scintigraphic images, but the definition of the images may be regarded as satisfactory since in one case the scintigram showed up a tumorous formation estimated to measure 2 cm at that time. (auth)

48156 NEW TECHNIQUE FOR SCANNING THE PANCREAS. Ephraim, K. H. (Rotterdamsch Radio-Therapeutisch Instituut, Rotterdam). pp 721-8 of Medical Radioisotope Scintigraphy. Vol. II. Vienna, International Atomic Energy Agency, 1969.

From Symposium on Medical Radioisotope Scintigraphy, Salzburg, Austria. See STI/PUB-193(Vol.2); CONF-680804-(Vol.2).

The difficulties in visualizing the pancreas are partly caused by the high uptake of selenomethionine in the liver. A simple technique was developed to prevent data registration during the time the detector is moving above the liver. The technique is based on the fact that both ^{75}Se and ^{99m}Tc emit γ rays of 140-keV energy. The pulses, normally going from the single-channel analyzer to the registrating units, are deviated through a rate-meter to an API contactless optical meter relay (model API-compack I) and then passed on to the registrating units. The patient is given the normal dose of Se-methionine and everything is prepared for normal pancreas scanning with only one exception: The window of the single-channel analyzer is tuned in on the 140-keV photopeak. The patient is given 2 mCi of ^{99m}Tc colloid intravenously and the controls on the meter relay are adjusted in such a way that no pulse from the single-channel analyzer passes to the registrating units unless the activity is beneath the activity level in the liver. Then the scanning machine is started. The technique was developed to help smaller clinical isotope laboratories that cannot afford the combination of a γ camera with a special-purpose computer. (auth)

48157 DIAGNOSIS OF STOMACH CARCINOMA BY RADIOISOTOPE SCANNING. Czerniak, P.; Meytes, E.; Sinkover, A.; Bank, H. (Univ. of Tel Aviv, Israel). pp 737-51 of Medical Radioisotope Scintigraphy. Vol. II. Vienna, International Atomic Energy Agency, 1969.

From Symposium on Medical Radioisotope Scintigraphy, Salzburg, Austria. See STI/PUB-193(Vol.2); CONF-680804-(Vol.2).

Scanning of the stomach after administration of ^{131}I and ^{99m}Tc is presented. Experiments on 20 dogs were performed and 105 patients were examined. The studies with ^{131}I are only mentioned briefly. ^{99m}Tc and stomach carcinoma are investigated in depth. The turnover of the nuclide in blood, urine, gastric juice, and gastric mucosa was tested; in vivo and post-operative scannings were performed. The scans are classified in four groups. Carcinoma of the stomach results in space-occupying lesions or foggy scans. A correlation of 85 to 90% between scan results and clinical findings is noted. A special group of 10 volunteers was examined to establish the possibility of a screening examination for the detection of stomach cancer using the technique presented. (auth)

48158 ^{75}Se-SELENOMETHIONINE AS TUMOR DIAGNOSTIC AGENT. CLINICAL AND EXPERIMENTAL STUDY. Jovanovic, D.; Bouckaert, A. (Cancer Inst., Louvain, Belg.). pp 753-66 of Medical Radioisotope Scintigraphy. Vol. II. Vienna, International Atomic Energy Agency, 1969.

From Symposium on Medical Radioisotope Scintigraphy, Salzburg, Austria. See STI/PUB-193(Vol.2); CONF-680804-(Vol.2).

The distribution pattern of ^{75}Se-selenomethionine as seen with the Anger scintillation camera in normal subjects and in cancer patients is described. The selective uptake of this radionuclide by malignant tumors of all histological types, i.e.: malignant lymphoma, sarcomas, and carcinomas, was observed in cancer patients. The diagnostic accuracy approached the 95% level. No region of significant abnormal uptake was seen in either the control patients or in the normal subjects. Locally cured cancer patients exhibited the same morphological distribution of radioactivity as normal man. The behavior of the plasma radioactivity and the pattern of uptake by malignant tumors indicate the presence of a mechanism whereby the tumor traps the ^{75}Se-selenomethionine directly from the blood stream rather than the concentrates already synthesized and the selenomethionine-labeled plasma proteins. (auth)

48159 SCINTILLATION SCANNING IN STUDYING REGIONAL ARTERIAL FLOW OF THE EXTREMITIES IN VASCULAR DISORDERS OF CONNECTIVE TISSUE. Fraga, A.; Mintz, G.; Cuaron, A.; Guerrero, M. (Hospital General del Centro Medico Nacional, Mexico City). pp 767-71 of Medical Radioisotope Scintigraphy. Vol. II. Vienna, International Atomic Energy Agency, 1969. (In Spanish).

From Symposium on Medical Radioisotope Scintigraphy, Salzburg, Austria. See STI/PUB-193(Vol.2); CONF-680804-(Vol.2).

Results of a study involving the injection of ^{131}I-labeled macroaggregated albumin (MAA) into the arterial trunk of the extremity are presented, followed by scanning of the limb in question, for the purpose of investigating variations in regional articular flow in the proximal portions of the extremities of patients suffering from vascular disorders of connective tissue. In patients suffering from acute, active polymyositis, scanning shows an extensive buildup of radioactivity in the proximal muscular masses of the limb, due to their hyperaemia. In the case of chronic slightly active polymyositis it shows an appreciable reduction in the accumulation of radioactivity in the said regions, due to cicatricial factors and to fibrosis. In cases of morphoea, an extensive buildup of radioactivity, due to hyperaemia, was observed in the areas underlying the sclerotic patch. In nodular polyarthritis, it was possible to identify the zones of vasculitis, that appeared in the scintigram as true accumulations of radioactivity. This method is rapid, simple, and devoid of serious inconvenience to the patient. (auth)

48160 ENDOTHELIAL LESIONS. DEMONSTRATION BY SCINTISCANNING. Webber, M. M.; Webb, R. C.; Cragin, M. D. (Univ. of California, Los Angeles). Contract AT(04-1)-GEN-12. pp 773-80 of Medical Radioisotope Scintigraphy. Vol. II. Vienna, International Atomic Energy Agency, 1969.

From Symposium on Medical Radioisotope Scintigraphy, Salzburg, Austria. See STI/PUB-193(Vol.2); CONF-680804-(Vol.2).

Collections of tracer accumulations were noted in the auxillary regions on certain patients who have undergone pulmonary scanning. Reviewing these cases it was noted that a common denominator existed. The patients were subjected to venous catheterization with the purpose of administering intravenous fluids. A catheter was inserted and remained in place for a variable length of time. In some cases accumulation of tracer was seen in the axillary region on repeat lung scans several weeks after the removal of the catheter. An experimental method was developed in which focal vascular lesions were created within the vascular system. The method consisted of the use of an electrocautery electrode at the end of an intravascular catheter. Electrocautery was applied to the wall of the vessel under fluoroscopic control. After creation of the lesions, tracer doses of various substances including radiotechnetium-labeled albumin macroaggregates were introduced intravascularly. Scintiscanning techniques were used to permit visualization of the distribution of tracer. The distribution of tracer following the production of intravenous and intraarterial lesions is discussed. It is expected that this technique may be applied to many situations in which the vascular endothelium is damaged. Possible applications include demonstration of vascular disease, such as thrombophlebitis, localized vasculitis, and arteriosclerotic ulceration. (auth)

48161 ORGAN AND TUMOUR LOCALIZATION WITH RADIOISOTOPES. A GUIDE TO RECENT LITERATURE. pp 781-903 of Medical Radioisotope Scintigraphy. Vol. II. Vienna, International Atomic Energy Agency, 1969.

From Symposium on Medical Radioisotope Scintigraphy, Salzburg, Austria. See STI/PUB-193(Vol.2); CONF-680804-(Vol.2).

A bibliography of 2505 references to recent literature is presented on the following subjects: physics and techniques, moving detector devices, general; physics and techniques, moving detector devices, collimation; physics and techniques, moving detector devices, data presentation; physics and techniques, moving detector devices, computer treatment; clinical results, brain; clinical results, spinal canal; clinical results, eyes; clinical results, thyroid gland; clinical results, parathyroid glands; clinical results, salivary glands; clinical results, heart; clinical results, lungs; clinical results, breast; clinical results, stomach; clinical results, liver; clinical results, spleen; clinical results, pancreas; clinical results, kidneys; clinical results, female genital organs; clinical results, placenta; clinical results, male genital organs; clinical results, bone; clinical results, bone marrow; clinical results, skin; clinical results, lymphatics; clinical results, other organs; clinical results, tumors in general; review articles, technical; review articles, clinical; and books and conference proceedings. (H.B.G.)

48162 APPROACH TO A STORAGE AND DATA HANDLING PROCEDURE IN STATIC AND DYNAMIC SCINTIGRAPHY. Goris, M.; De Roo, M. J. K.; Vanderschueren, G. (Centrum voor Gezwelziekten, Louvain, Belg.). J. Belge Radiol., 52: 168-89(1969).

The alternative possibilities of digital display are reviewed following the description of some limitations of the analogic displays. A detailed description is also given of the physical appraisal and the methods of storage-display and data handling for both static and dynamic quantitative scintigraphy with the gamma camera as scanning apparatus. Numerous examples of both procedures are given as illustration of the practical possibilities of the forementioned scintigraphic techniques. (auth)

48163 MODERN DEVELOPMENTS IN NUCLEAR MEDICINE. Rathje, W. Therapiewoche, 19: 1686-8(Sept. 1969). (In German).

Diagnostic application of radioisotopes is briefly reviewed. Well known principles are discussed for various organs. (H.B.G.)

Radiotherapy

Refer also to abstracts 47679, 47934, 47988, 47989, 48046, 48052, 48056, 48238, 48239, 48241–48248, 48251, 48252, and 49284.

48164 CONSERVATIVE MANAGEMENT OF UVEAL MALIGNANCIES. Galbraith, J. E. K. (Melbourne Univ., Parkville, Australia). Aust. N. Z. J. Surg., 38: 349-54(May 1969).

The results of conservative treatment of a series of intraocular malignant melanomas are presented. Tumors of the anterior uvea were excised, while those posteriorly situated were irradiated from a local source containing radon. Details are presented of the construction and use of the radioactive applicator. (Australia)

48165 PROGRESS IN RADIOLOGY. SYMPOSIA AND INVITED PAPERS OF THE XIth INTERNATIONAL CONGRESS OF RADIOLOGY, ROME, 22–28 SEPTEMBER, 1965. VOLUME I. Turano, L.; Ratti, A.; Biagini, C. (eds.). International Congress Series No. 105. New York, Excerpta Medica Foundation, 1967. 1014p. (In Several Languages). (CONF-650907-(Vol.1)).

One hundred and thirty one papers presented at the conference are included. Separate abstracts were prepared for eight papers. Additional papers are included on various aspects of radiodiagnosis and radiotherapy. (H.L.W.)

For abstracts of individual papers see: 47963, 48166–48171, and 48210.

48166 TISSUE REACTIVITY, POTENTIATION OF RADIATION EFFECTS, AND FRACTIONATION OF DOSE. Jolles, B. (General Hospital, Northampton, Eng.). pp 759-64 of Progress in Radiology. Vol. I. Turano, L.; Ratti, A.; Biagini, C. (eds.). New York, Excerpta Medica Foundation, 1967.

From 11th International Congress of Radiology, Rome. See CONF-650907-(Vol.1).

Details of experimental studies using rabbits on tissue reactivity to irradiation, its abolition and restoration, and the underlying enzymic processes are described. The advantages of the anchorage afforded by volumes of unirradiated tissues in sieve therapy and by a fractionation of dose in time, based on the period required for the restoration of the tissue responsiveness, are stressed. The role of proteases and vasoactive compounds and the immunological implications of the findings are discussed. (auth)

48167 QUANTITATIVE ASPECTS OF THE MECHANISM OF CELL DEATH FOLLOWING RADIOTHERAPY. De Waard, R. H. (Univ. Inst. of Medical Radiology, Utrecht). pp 766-70 of Progress in Radiology. Vol. I. Turano, L.; Ratti, A.; Biagini, C. (eds.). New York, Excerpta Medica Foundation, 1967.

From 11th International Congress of Radiology, Rome. See CONF-650907-(Vol.1).

In cells of normal epidermis and of epidermal tumors, 1 to 2 × 10^{10} out of 2 to 3 × 10^{10} electrons per daughter cell, which belong to hydrogen-bound N and O atoms of DNA molecules are targets. In the lifetime T of these cells (~1,000 hours), the hydrogen-bond of any of these atoms is released for 2 to 4 periods of about 6 hours in normal cells and for some 6 to 12 periods in tumor cells, one corresponding to DNA synthesis and the other(s) to RNA formation. When in such a period a target electron is detached from its atom, the corresponding daughter cell will either fail to develop or be nonviable. It is clear that these conclusions are only preliminary and await confirmation by clinical observations and by experiments. The basic concept, however, is in quantitative agreement with the main facts of radiotherapy, and it could, therefore, serve as a starting point in the development of new therapeutic techniques and in the planning of radiobiological experiments. (auth)

48168 CLINICAL EXPERIENCE WITH HIGH AND LOW LET RADIATION. Stone, Robert S.; Louie, Rose V.; Adams,

Gail D. (Univ. of California, San Francisco). pp 893-8 of Progress in Radiology. Vol. I. Turano, L.; Ratti, A.; Biagini, C. (eds.). New York, Excerpta Medica Foundation, 1967.

From 11th International Congress of Radiology, Rome. See CONF-650907-(Vol.1).

Fast neutron therapy by the various methods of fractionation and protraction used by Stone and Larkin in the period from 1938 to 1943 was too destructive for normal tissue when given in doses that killed cancer. Possibly some other pattern of application can be devised that will take advantage of the low oxygen effect with high LET radiations. Supervoltage x-rays in the 1000-Kv range are superior to fast neutrons and orthovoltage x rays because the cancers can be effectively irradiated with much less damage to the skin. They are inferior to 70-Mv x rays in the treatment of deep seated cancers because of the total volume dose and the complicated cross-firing or rotational patterns that must be used. Seventy million volt x rays are the most satisfactory to use because: the low volume dose results in low systemic effects on the patients; the primary and late skin effect produces little or no discomfort; the simplicity of the field arrangements allows great accuracy with ease and speed; the whole tumor containing volume can be uniformly irradiated each treatment day. No increased cure rates have been established, as yet, as a result of using 70-Mv x rays. Complications due to the unavoidable radiating of normal structures adjacent to the cancer are still a problem. (auth)

48169 PHYSICAL ASPECTS OF THE FAST NEUTRON BEAM FROM THE MEDICAL RESEARCH COUNCIL CYCLOTRON. Parnell, C. J.; Bewley, D. K.; Field, S. B. (Hammersmith Hospital, London). pp 907-13 of Progress in Radiology. Vol. I. Turano, L.; Ratti, A.; Biagini, C. (eds.). New York, Excerpta Medica Foundation, 1967.

From 11th International Congress of Radiology, Rome. See CONF-650907-(Vol.1).

Collimators for the Medical Research Council cyclotron are described. Various aspects of neutron dosimetry and penetration of neutrons into tissue are discussed. Experiments to assess the effects of fractionated neutron and x radiation on the response of transplanted rat fibrosarcoma are being set up in an attempt to discover if radiotherapy with fast neutrons will still be of value when fractionated treatments are given. Tests are being carried out on volunteer patients to see if human skin reacts to neutron irradiation in the same way as pig and mouse skin, and to act as a guide in human radiotherapy. (H.L.W.)

48170 POTENTIALITIES FOR FAST NEUTRON BEAM CANCER RADIOTHERAPY. Andrews, J. Robert; Hollister, Herbert (Georgetown Univ., Washington, D. C. Kaman Aircraft, Inc., Colorado Springs). pp 914-20 of Progress in Radiology. Vol. I. Turano, L.; Ratti, A.; Biagini, C. (eds.). New York, Excerpta Medica Foundation, 1967.

From 11th International Congress of Radiology, Rome. See CONF-650907-(Vol.1).

The biophysical validity for investigating human cancer radiotherapy by 14-MeV fast neutron irradiation is discussed. A table is presented to show mammalian cell dose-survival curve characteristics for ^{60}Co γ radiation, 14-MeV fast neutrons, and fission spectrum fast neutrons. A graph is presented to show relative depth dose curves of 250-kVp x rays, ^{60}Co γ rays, 0- to 19-MeV fast neutrons, and 14-MeV fast neutrons. Technical problems concerned with 14-MeV fast-neutron radiotherapy of cancer are considered. (H.L.W.)

48171 HIGH-ENERGY PROTONS IN RADIOTHERAPY. RECENT DEVELOPMENTS. Graffman, Sten; Jung, Bo; Larsson, Borje; Sarby, Bert; Stenson, Stig; Stahl, Kay; Svedberg, The (Univ. of Uppsala). pp 921-6 of Progress in Radiology. Vol. I. Turano, L.; Ratti, A.; Biagini, C. (eds.). New York, Excerpta Medica Foundation, 1967.

From 11th International Congress of Radiology, Rome. See CONF-650907-(Vol.1).

The synchrocyclotron for producing 185-MeV proton beams is described. A graph showing calculated depth-dose curves for 200-MeV protons in soft tissue is presented. The RBE of high energy protons for tumor therapy and for chromosome aberrations is discussed. It was demonstrated that local hypoxia had a protective effect during irradiation of mucous membrane. A table is presented to show effects of high-energy protons, deuterons, and alpha particles on neoplasms of the brain, nasopharynx, pituitary gland, and pelvic organs. (H.L.W.)

48172 OVULATION INDUCTION WITH X RAYS. Gimenez Miranda, J. Martin (Hopital Central Militar, Mexico City). Ginecol. Obstet. Mex., 22: 11-28 (Jan.-Feb. 1967). (In Spanish).

Clinical studies on the use of x irradiation to induce ovulation in infertile women are reported. Out of a total of 168 patients with anovulatory ovarian insufficiency, 43 were selected for irradiation Their age ranged from 20 to 39 yr, and in 34 sterility was primary and in 9 it was secondary. Both ovarian and pituitary irradiation with 200-kV x rays was carried out with single doses of 50 R to temporal fields and 50 R to anterior pelvic and 75 R to posterior pelvic fields. Total doses up to 150 rad were given, on the basis of a single dose per week. Irradiation was begun 5 to 8 days after induced or spontaneous menstruation. In 70% of cases, regularization of the menstrual cycle was obtained, in 9% on a temporary bases, and in 21% only negative results. Pregnancy ensued in 70%, in 7% in the 1st month postirradiation, 3% in the 2nd, and 44% in the 3rd. No evidence of harmful mutations as a result of the treatment was seen. The possibility that such irradiation might induce mutations and some possible means by which hypophyseal and ovarian irradiation may induce ovulation are discussed. (BBB)

48173 MYELOPATHY FOLLOWING RADIOTHERAPY OF NASOPHARYNGEAL CARCINOMA. Hung, Tsu-pei (National Taiwan Univ., Tapei). Proc. Aust. Ass. Neurol., 5: 421-8 (1968).

Eighteen cases that developed cervical cord and/or brain stem lesions as the result of successful radiation of nasopharyngeal carcinoma are described. This group constituted 6.2% of 226 cases of nasopharyngeal carcinoma treated by telecobalt techniques during a 3 yr period. The neurological complications began 8 to 33 months following the conclusion of therapy with a mean interval of 22 months. Eight patients died, having survived 3 to 29 months following the onset of myelopathy and the death was attributed to either inanition with urinary tract infection, or respiratory failure. In the survivors, the neurological changes arrested in seven cases, but continued to progress in three. The mode of onset is described and three major clinical presentations are identified: upper cervical cord involvement usually resulting in a partial or complete Brown-Séquard syndrome, partial bulbar palsy, combined cervical and bulbar involvement. These sites correlated well with the predicted portals of irradiation and in those with cord involvement, the use of an unusually large dose of radiation was thought to be the major factor responsible for this complication. It was noted, however, that individual susceptibility varied greatly, and the changes in the two halves of the cord could not be explained on the basis of uneven radiation. (auth)

48174 EXTRACORPOREAL IRRADIATION OF THE BLOOD IN CHRONIC LYMPHOID LEUKEMIA. Schiffer, L. M.; Chanana, A. D.; Cronkite, E. P.; Greenberg, M. L.; Rai, K.; Stryckmans, P.; Vincent, P. (Brookhaven National Lab., Upton, N. Y.). Nouv. Rev. Franc. Hematol., 8: 691-9 (Sept.-Oct. 1968). (In French).

Extracorporeal irradiation of the blood was used in chronic lymphocytic leukemia in an attempt to define limits of usefulness in the treatment of this disease and to determine whether the technique can be used as a research tool for investigation of the basic disease process. Eleven patients with chronic lymphocytic leukemia were submitted to daily extracorporeal irradiation of their blood. The irradiator was a source of ^{137}Cs or ^{60}Co. The transit dose varied from 236 to 498 rad, and the average daily exposure to irradiation was 4 hr. A marked reduction in the blood lymphocyte count was observed in most patients. This reduction was exponential and generally considerable. A reduction of volume of lymph nodes and spleen was seen in 5 patients but it was less prominent than for the circulating lymphocytes. No toxicity to the bone marrow was observed. Improved erythropoiesis and megakaryopoiesis were observed in some cases. The secondary effects of the procedure were minor, but included febrile episodes. (BBB)

48175 SPLENIC RADIOTHERAPY IN THE TREATMENT OF CHRONIC LYMPHOCYTIC LEUKEMIA, ITS ANALOGIES TO EXTRACORPOREAL IRRADIATION. Schlienger, M.; Parmentier, C.; Laugier, A.; Schlumberger, J.; Bok, B.; Mathe, G.; Tubiana, M (Institut Gustave-Roussy, Villejuif, France). Nouv. Rev. Franc. Hematol., 8: 719-32 (Sept.-Oct. 1968). (In French).

Results of treating 33 patients with chronic lymphocytic leukemia and varying degrees of bone marrow insufficiency with splenic irradiation are presented. The first 14 received 900 rad in 19 sessions of 50 rad each; 11 others, 450 rad in 18 sessions of 25 rad; and three more, 700 rad in twice daily sessions of 12.5 rad each. The results obtained in these three series are compared. The diminution of the number of lymphocytes during irradiation was similar in the three groups. The prognosis was better when the antilymphocytic action was selective, and the fall of the lymphocyte count more rapid. The diminution at the beginning of the treatment allowed an estimate of the later decrease. Splenic irradiation reduced the degree of ineffective erythropoiesis; it increased erythroblastic aplasia in patients with only a small lymphocyte decrease during irradiation. Conversely, when the number of lymphocytes decreased, the bone marrow erythrocytic activity seemed to increase. The effects of splenic irradiation were compared with those of extracorporeal irradiation, and the advantages of the

first method cited. Much lower doses can be used with splenic irradiation and dosimetry is more accurate. (BBB)

48176 A QUANTITATIVE ANALYSIS OF TREATMENT SCHEMES WITH VARIOUS TYPES OF RADIATION. Wideroe, R. Atomkernenergie, 14: 352-6(Sept.-Oct. 1969).

Radiobiological effects can be described and understood by means of a theory based upon a very simple model (the two-component model) of the ionizing radiation. In radiotherapy different effects are recognized such as: devitalizing of normal and tumor cells, conversion of anoxic to euoxic tumor cells during the treatment and repopulation of normal cells after each treatment session. The situation and interplay of the various reactions are analyzed by means of the two-component theory. Various types of radiation are compared and the most suitable single doses for each case evaluated. The calculations are based on certain assumptions and they also indicate directions for further research. (auth)

48177 RECENT ADVANCES IN RADIATION THERAPY. Tsukamoto, Kempo (National Cancer Center, Tokyo). Niigata Igakkai Zasshi, 82: 775-8(Dec. 1968). (In Japanese).

Radiotherapy of cancers has made a remarkable progress for recent 10 years. Among causes of this progress a rapid development of radiation apparatuses is mentioned. By using these apparatuses, it is made possible to irradiate the deep-seated tumors with a sufficient dose, giving the minimum possible damage to normal tissue around the tumor. The second cause is an advance in radiation biology, and for example, in order to enhance the radiosensitivity of the tumor tissue, the combined use of hyperbaric oxygen or radiosensitizers with the irradiation is now actually carried out for treating cancers. The recent results and new techniques of treatment in National Cancer Center are summarized as follows: when the results in radiotherapy of cancers of head and neck obtained at Hospital of National Cancer Center in 1966 are compared with those obtained at Hospital of Cancer Institute in 1957, 3 yr survival rate rises from about 30% to about 60%, and cancers that were treated by Ra-needling with good results previously are treated mainly by lineac x-ray at present also with good results. As a new technique, there is surgical irradiation which irradiates tumor tissue from a short distance with a single massive dose by Betatron electron beam after laparotomized by surgeons. This technique is now applied for treating cancers of pancreas and urine bladder. Some of those cases, that were never cured by operation or irradiation alone previously, are now treated with good results by the combined powerful therapy of irradiation, operation, and chemotherapy. Further, a study is now carried on to throw a picture of spatial dose distribution immediately, by utilizing electronic computer and to control automatically the dose delivered to tumor tissue. (NSA of Japan)

48178 PYRAMIDAL PARALYTIC SYNDROMES CAUSED BY MYELITIS DUE TO IRRADIATION OF THE CRANIO-CERVICAL REGION. Cherubino, M.; Guccione, G. (Univ., Pavia, Italy). Arch. Ital. Otol., Rinol., Laringol., 79: 157-70(Mar.-Apr. 1968). (In Italian).

A neurological complication of radiotherapy in two subjects treated with high energies (^{60}Co, Betatron) is described. Following a review of the literature on these lesions following irradiation of the cervical region, attention is given to the clinical and neurological pattern as well as to medullary histopathological lesions. Finally the aspects of differential diagnosis are underlined between radiation myelitis, extramedullary compressions due to metastases and cervical arthrosis that may even require the intervention of the neurosurgeon to reach a final assessment. (auth)

48179 HISTOLOGICAL CHANGES OF THE HUMAN LARYNX IRRADIATED WITH THE VARIOUS TECHNICAL THERAPEUTIC METHODS. Manara, G.; Mira, E. (Univ., Pavia, Italy). Arch. Ital. Otol. Rinol. Laringol., 79: 596-635(Sept.-Oct. 1968). (In Italian).

A histopathological study of radiation lesions of the human larynx was carried out on a number of specimens from patients that had undergone different radiotherapic procedures (x ray, ^{60}Co, electron beam) and subsequent laryngectomy. In the epithelial lining, after completion of the course of irradiation, the following observations were made: first, increased activity of the intercalated goblet cells and islands of squamous metaplasia; later, acanthosis and hyperkeratosis of the covering pavimentous epithelium; finally, marked atrophy over all the laryngeal mucous membrane. Likewise the tubo-acinous laryngeal glands showed an early increased activity, especially of the serous secreting cells, followed by atrophy of most acini with occurrence of cystic dilatation of the ducts and inflammatory infiltration of the interstitial connective tissue. In the laryngeal connective tissue as a whole, at the beginning a strong inflammatory reaction took place with many newly formed capillaries and small blood vessels, edema and leucocyte infiltration, then the connective tissue grew into hyaline sclerotic scar tissue without visible cells and blood vessels and with fragmentation of the elastic fibers. Within the connective tissue, alterations of the blood vessels, and especially of the small arteries were noted: first, in the form of swelling and proliferation of the endothelial cells, and then, with fibrosis of the tunica media and adventitia, fragmentation of the elastic laminae and disappearance of the smooth muscle fibers; at the end, thrombosis and obliteration of the lumen were often seen. The cartilage reacted with thickening and fibrosis of the perichondrium, degeneration and necrosis of the cartilage cells, irregular staining of the ground substance; while striated muscle showed waxy degeneration and fragmentation of single fibers followed by connective tissue proliferation. It was assumed that most alterations were related to time elapsed since the termination of the radiotherapy but, conditions being equal, the dose too was of some importance, especially to the epithelial impairment; on the contrary different types of irradiation (x ray, ^{60}Co supervoltage) caused little difference in the histological picture, only connective tissue being somewhat more sclerotic after cobaltotherapy. Tissue reactions to radiotherapy was also related to age, sex, local damage induced by malignancy, and to the particular biological conditions of each individual. (auth)

48180 ON THE FUNCTIONAL STATUS OF THE NERVOUS SYSTEMS OF CHILDREN AT LONG PERIODS AFTER IRRADIATION (THE APPLICATION OF GAMMATHERAPY TO SKIN HEMANGIOMAS). Glazunov, I. S.; Tereshchenko, N. Ya. Zh. Nevropatol. Psikhiat., 68: 1438-45(1968). (In Russian).

A repeated study (neurological and clinico-psychological) was carried out on 79 children, that were subjected to applicational γ-therapy by radioactive cobalt for skin hemangioma in the area of the head and face (60) and on the body and extremities (19). Most of the children at the time of radiation were from 2 months to 1 year. The total radiation doses, according to the tables of Patterson and Parker constituted 560 to 5520 R (28.3 to 3,122 mg/hour at a distance source to skin of 0.5 to 2 cm). At the present this method is not used. In almost all cases there were post-radiational skin changes in the form of dyschromia, sclerodermia, telangiectasia, epilation. In separate cases there were disturbed structures of the near lying bones. In singular cases radiation cataracts developed. The most frequent complaints following radiation of the head were headaches, increased fatigability and memory impairment. In 7 out of 18 children subjected to radiation in total doses from 1500 to 2000 R there were asthenic and asthenovegetative changes. In irradiation of the head in doses higher than 2000 R the cerebrasthenical syndrome was encountered more frequently. When these children attained the age of 12 to 13 yr some of them demonstrated a disturbance of the vegetative—vascular and vegetative—endocrine regulation. In two cases the clinical and clinico-physiological picture pointed to a prevalent focal lesion in the limits of the irradiated thoracic segments (total doses 1539 R to 2589 R). (auth)

48181 STUDY OF LYMPHOCYTE RENEWAL IN CHRONIC LYMPHOID LEUKEMIA. Perry, S. (National Cancer Inst., Bethesda, Md.). Nouv. Rev. Franc. Hematol., 8: 625-36(Sept.-Oct. 1968). (In French).

Leukocyte survival times and body distribution patterns were studied in humans, particularly in one case of leukemia subjected to whole-body irradiation. Most lymphocytes in the blood are nonproliferating, long-lived, and recirculate between the blood and thoracic duct lymph, passing through lymph nodes, Peyer's patches, and spleen. In chronic lymphocytic leukemia (CLL) the predominant lymphocyte has a long survival time and it may gradually accumulate, resulting in organ enlargement. Leukokinetic patterns in the peripheral blood leukocytes were studied after the intravenous administration of tritium-labeled thymidine, utilizing radioautography and liquid scintillation counting. Two types of leukocyte kinetic patterns were observed. The first pattern was consistent with a small population of an actively proliferating, short-lived population of lymphocytes. Peaks of specific activity occurred at 100 to 200 hr after administration of the tritium-labeled thymidine, with a maximum labeling index of 2.5%. This pattern was found in patients without organomegaly and with relatively low peripheral lymphocyte counts. The second pattern consisted of long-lived lymphocytes with little proliferative potential. Leukocyte specific activity was consistently low and no definite peaks were observed. The maximum labeling index was never above 0.5%. Patients with this pattern, in contrast with the patients with the first type, had significantly organomegaly and higher lymphocyte counts. In one patient, pattern two was converted to pattern one following splenectomy. Another patient was studied after partial remission achieved with fractionated whole-body irradiation. The leukocyte kinetic curve in this patient was

similar to that seen in normal individuals. The organ distribution of autologous leukocytes labeled in vitro with ^{51}Cr was studied in a few patients with CLL. Body-surface scanning showed that patients with pattern one have no selective localization of labeled white cells, as in normal individuals. On the other hand, in patients with pattern two, there is transient trapping of labeled leukocytes followed by pooling in the spleen. (BBB)

48182 COMPOSITE ISODOSE CALCULATION WITH A DIGITAL COMPUTER APPLICATION TO TOTAL PELVIS IRRADIATION IN CERVICAL CARCINOMA WITH TELECOBALT RADIATION. DeBois, J. M.; De Baene, J.; Van de Kerkhoven, J. (Univ. Hospital, Louvain, Belg.). J. Belge Radiol., 52: 190-5(1969).

There is great interest in the computer calculations of composite isodose curves in external cobalt irradiations. The availability at this hospital of an IBM 1440 computer prompted studies of treatment planning for cervical carcinomas using the telecobalt units. (E.R.B.)

48183 CALCULATION OF RADIATION TIME IN TELECOBALT THERAPY BY MEANS OF AN ORDINATOR. Prigot, Michelle; Wambersie, A. (Univ., Louvain, Belg.). J. Belge Radiol., 52: 196-9(1969). (In French).

A program developed to calculate the irradiation time in telecobalt therapy is described. The program was adapted to a small computer (IBM 1440). Several parameters were taken into account: the dose to be delivered, the SSD (or STD), the field size, and the tissue-air-ratio (T.A.R.). In order to reduce the number of memories needed, the T.A.R. factors were calculated as a function of the field size and of the depth by means of polynomes, whose coefficients were determined by the classical least square method. An enlarged program adapted to a 360.40 unit is also presented; it allows for more information. (auth)

48184 PRIMARY RETICULUM CELL SARCOMA OF THE SKULL. RESPONSE TO IRRADIATION. Topolnicki, W.; White, Robert J. (Cleveland Metropolitan General Hospital, Case-Western Reserve Univ., Cleveland). Cancer, 24: 569-73(Sept. 1969).

Pathologic, radiologic, and diagnostic aspects of primary reticulum cell sarcoma of bone are discussed. A case of primary reticulum cell sarcoma of the skull is reported. This type of lesion is extremely uncommon; only 3 documented cases have previously been reported. All 4 cases have similar clinical features and, by comparing these with reticulum cell sarcoma of other bones, it appears possible that these are relatively more common in women, occur in older age groups, are less aggressive, and do not metastasize as rapidly. Response to adequate irradiation is excellent, and the prognosis appears to be good. Tumor dose of about 4000 rads delivered in 4 weeks is considered satisfactory. (auth)

Blast and Thermal Effects

Refer also to abstract 48248.

Radiation Effects on Animals

Refer also to abstracts 47979, 48020, 48025, and 48083.

48185 EXCEPTIONAL LYMPHOCYTE STIMULATING CAPACITY OF CELLS FROM LYMPHOID CELL LINES. Hardy, D. A.; Ling, N. R.; Knight, S. C. (Univ. of Birmingham, Eng.). Nature (London), 223: 511-12(Aug. 2, 1969).

It was found that X-irradiated lymphoid cells from a Burkitt lymphoma cell line were exceptionally potent activators of normal human lymphocytes. The action appears to resemble the much less intense lymphocyte activation which occurs when lymphocytes from two donors are mixed in culture (mixed lymphocyte reaction). With a view to trying to define the nature of the high level activation the effect was examined of mixing lymphocytes with irradiated cells from other human lymphoid cell lines, some of which contained a herpes-like virus. Marked activation occurred in all mixtures tested. Experimental work was designed to answer the following questions: (a) Is the action a true stimulation of the peripheral lymphocytes by the irradiated cells or is it caused by a viral transfer or by abnormal survival of the irradiated cells; (b) does the cell act purely as a "carrier" of antigen or does it play some additional role in the stimulatory process; (c) is the magnitude of the response related in any way to the higher metabolic activity of the X-irradiated free growing lymphoid cells. With regard to (a), it was concluded that the virus was not responsible for the activation; also no evidence was found that the normal peripheral cells acted in some protecting role, delaying the death of the X-irradiated cells, or as stimulatory agents inducing surviving irradiated cells to synthesise DNA by overcoming the metabolic block introduced by irradiation. The evidence indicated that the action is a stimulation of normal blood lymphocytes by the X-irradiated cells. With regard to (b), it appeared that whole cells, if not viable cells, are necessary for maximal stimulation. With regard to (c), it appeared that most of the stimulation depended on membrane antigens on the cells rather than on their high metabolic state, and direct cell-cell contact appeared necessary. Factors contributing to the stimulation are proposed. (UK)

48186 FATE OF THE CELLULAR ELEMENTS IN FASCIAL GRAFTS. West, R. D.; Crawford, J. S.; Basu, P. K. (Univ. of Toronto). Can. J. Ophthal., 4: 64-71(1969).

Tissue culture and sex chromatin staining were used to study the fate of the cells in fascial grafts. In thirty-eight grafts implanted within the corneal stroma subcutaneously and subconjunctivally, eleven failed to grow in tissue culture and probably represent failures of technique. In 13 cases donor cells survived for periods of up to three months after implantation. In fourteen cases host cells had completely replaced the original cells and in a further four cases they appeared to be in the process of doing so. Donor cells survived for longer in corneal grafts than in subcutaneous and subconjunctival ones, probably because of the lesser vascular reaction to intracorneal grafts. Human irradiated grafts at these sites did not become invaded by host cells up to twenty-four weeks after implantation. Live fascial strips, implanted in apposition did not join together in any of sixteen cases but became encased in a sheath of the host animal's fibrous tissue. The survival of the cells of fascial grafts appears to be proportional to the speed and degree of the hosts' vascular reaction to the graft. It is believed that eventually all the original graft cells die and are replaced by fibroblasts from the host. Further work on this cellular replacement is proposed using serial biopsies. It was also shown that fat, if present as a contaminant, provokes a severe immune response and adversely affects the survival of graft cells. (auth)

48187 ALKYLATION DAMAGE AND ITS REPAIR. Strauss, B.; Coyle, M.; Robbins, M. (Univ. of Chicago). Cold Spring Harbor Symp. Quant. Biol., 33: 277-87(1968).

From 33rd Cold Spring Harbor Symposium, Cold Spring Harbor, N. Y. See CONF-680631.

A comparison was made of the repair of damage produced in both bacterial and mammalian cells by methyl methane sulfonate (MMS), uv light, and x radiation. The demonstration of repair from MMS-induced damage was based on the isolation of sensitive mutants, demonstration that the MMS-induced lesion is removed, and demonstration of repair synthesis. Incubation of MMS-treated cultures of Bacillus subtilis for a period of about a generation time prior to lysis resulted in an increase in the transforming activity obtained when the cultures are lysed, indicating the differential removal of the alkylated sites. The mechanism of MMS and uv repair differs, since uv-sensitive mutants need not be MMS-sensitive and MMS-sensitive mutants need not be sensitive to uv at low doses. Whether repair of damage induced by MMS occurs in the human tissue culture line HEP-2 and in peripheral blood lymphocytes was also tested. When the DNA of HEP-2 cells was treated in vitro with increasing concentrations of MMS, there was a decrease in the average sedimentation rate in alkaline sucrose gradients. Extracts of lymphocytes made by freezing and thawing cells had activity against alkylated but not uv-treated DNA. Activity could be demonstrated both by acid solubilization of ^{32}P-labeled Escherichia coli DNA incubated with extract in the presence of Mg^{++} and by transformation assay. Both human blood lymphocytes and calf thymus cells showed activity against alkylated but not uv-treated DNA. Evidently lymphocyte preparations can recognize MMS-treated DNA and the transformation tests showed that methylated sites can be recognized. A hypothesis is offered to account for the data, for the mutagenic activity of MMS and for the sensitivity of mutants to both x-ray and MMS-induced damage. Treatment with alkylating agents produces a mixture of DNA with alkylated sites and with single-strand breaks. An additional proportion of the alkylated sites is converted to single-strand breaks by enzyme action. The repair mechanisms found in both procaryotic and eucaryotic cells act on DNA with single-strand breaks but ignore alkylated sites that have not been converted to single-strand breaks by enzyme action. The hypothesis accounts for the differences between repair of uv- and of MMS-induced damage, since an enzyme system is required to convert DNA with uv-induced pyrimidine dimers to DNA with single-strand breaks, whereas MMS produces breaks both spontaneously and as a result of the action of a (different) enzyme on DNA with alkylated bases. (BBB)

48188 RANDOM FACTORS IN THE SURVIVAL CURVE. Kellerer, Albrecht M.; Hug, Otto (Univ., Munich). Advan. Biol. Med. Phys., 12: 353-66(1968).

Some statements on survival curves and some well-known arguments are mentioned. Then an alternative to the conventional treatment is given followed by some remarks on the different random factors governing the dose-effect relation. One detailed example is presented that brings out new aspects that were somewhat neglected. (auth)

Invertebrates

Refer also to abstracts 48289–48291, 48008, 48012, and 48015.

48189 HEAVY WATER AND HYDROSTATIC PRESSURE EFFECTS ON TETRAHYMENA PYRIFORMIS. Lowe-Jinde, Louise (Univ. of Guelph, Ont.); Zimmerman, Arthur M. J. Protozool., 16: 226-30(May 1969).

Whether heavy water would counteract inhibition of mitosis and cytokinesis by hydrostatic pressure in Tetrahymena was investigated. Heat-synchronized cultures of the strain GL subjected to pulses of high hydrostatic pressure (10,000 psi for 2 min) showed increasing division delays during the 1st 40 min after the last heat shock (40 min after heat treatment). Pressure treatment during the subsequent 10-min interval disrupted cell synchrony. Comparable pressures applied to the cells at later stages, before the 1st synchronous division, caused negligible division delay. Continuous exposure to 10% (vol/wt) heavy water hardly affected division, while higher concentrations delayed or blocked division. Ten-min pulses with heavy water (40%, 50%, 70%) resulted in increasing division delays depending on the stage of the cell cycle during which the heavy water was applied. Amelioration of the division-delaying effects of pressure was observed in cells treated simultaneously with pressure (3000 psi for 30 min) and 30% D_2O. The results indicated that some of the pressure and D_2O effects could be attributed to changes in the sol-gel state of the cytoplasm. (BBB)

48190 GAMMA IRRADIATION OF STENTOR POLYMORPHUS. Preece, Alan W. (Univ. of East Anglia, Eng.). J. Protozool., 16: 289-94(May 1969).

The effects of γ rays on survival, cell division, ciliary activity, and oxygen uptake, and the inter-relation of these effects in terms of dose and time scale were studied in a protozoan. The cells were irradiated with ^{60}Co at 525 rad/min to doses up to 388 Krad. The LD_{50} is 285 Krad but cell division is inhibited below this dose. After a high dose of radiation (above 330 Krad), some specimens had already disintegrated before irradiation was completed. Other cells showed no ciliary activity and were completely spherical. After lower doses (200 Krad), Stentor appeared spherical or elongated with a rounding of the holdfast and no obvious oral margin. Later the cell either regained the normal stentor shape or eventually lysed. The dose/survival curve had a well-defined threshold, indicating that multiple interactions are necessary to kill the cell. The LD_{50} was relatively high in comparison with other protozoa. The frequency of cilia in the membranellar band, measured stroboscopically, is reduced by 30% after 14.5 Krad, and abolished by higher doses. Recovery has a similar time scale to recovery of fission. A Clarke electrode was used to measure changes in oxygen uptake after irradiation. Depressions of up to 50% were found. Recovery followed a similar pattern to that of ciliary activity and cell division. (BBB)

48191 ULTRAVIOLET-MICROBEAM IRRADIATION OF REGENERATING STENTOR. Burchill, Brower R.; Rustad, Ronald C. (Case Western Reserve Univ., Cleveland). Contract W-31-109-ENG-78. J. Protozool., 16: 303-5(May 1969).

Ultraviolet irradiation delays the regeneration of missing feeding organelles in the ciliate Stentor coeruleus. Various regions of the macronucleus and cytoplasm of regenerating cells were irradiated with a microbeam of monochromatic (265 nm) uv light in an attempt to identify the radiosensitive cellular component. It was found that during the early stages of regeneration the macronucleus is more sensitive to uv-induced regeneration delay than the cytoplasm, but it was not possible to distinguish between direct and indirect effects. Damage to cortical primordia in middle or late stages leading to structural abnormalities appeared to result only from direct effects. The fact that delay occurred with greater frequency when nodes nearer the ramifying zone were irradiated suggests that some event of primary importance in this region of the cell was affected. Although the effect of cytoplasmic irradiation was significantly less than that of macronuclear irradiation, appreciable cytoplasmic damage did occur, as evidenced by the relatively high incidence of regeneration delay. Abnormalities which appeared when various parts of the oral primordium were irradiated, such as absence or resorption of the gullet and disfiguration of the oral primordium, appeared to be a consequence of direct cortical or cytoplasmic damage. (BBB)

48192 EFFECT OF OXYGEN ON THE FREQUENCY OF X-RAY INDUCED SOMATIC CROSSING OVER IN DROSOPHILA MELANOGASTER. Stauffer, H. (Univ. of California, Berkeley). Nature (London), 223: 1157-8(Sept. 13, 1969).

The enhancement of radiosensitivity by oxygen has been found in essentially all forms of life, in many biological and organic systems, and in genetic occurrences such as chromatid breaks, autosomal crossing over and sex-linked mutations. Evidence is described for an oxygen effect in somatic crossing over in the fruit fly. Larvae were exposed to 1,326R of X-radiation at a dose rate of 102 R/min. (UK)

48193 THE EFFECT OF X RADIATION ON THE REGENERATIVE EVENTS IN THE BRAIN OF AMBYSTOMA MEXICANUM. Richter, W. (Humboldt-Univ., Berlin). Z. Mikrosk.-Anat. Forsch., 79: 316-41(1968). (In German).

Changes in brain regeneration were observed in Ambystoma mexicanum after partial removal of the telencephalon and diencephalon and x irradiation of the head with a dose of 500 R or a whole-body dose of 200 R. After localized irradiation 49.1% of the animals died, and after whole-body irradiation 45% died 40 and 70 days later. Degenerative cell death was observed in white and grey matter of the brain. Other features observed included proliferation of connective tissue, delayed appearance of impaired mitoses, delayed and incomplete regeneration of the diencephalon, caudal closure of the dorsal part of the operated hemisphere, atrophy of the telencephalic hemisphere, regenerative connection involving the hippocampus primordium, and, rarely, the appearance of accessory ventricles. The matrix layers of the rostral parts of the telencephalon were insufficient for recovery of the caudal third of the hemisphere when the ventral matrix layer and the olfactory organ were damaged by irradiation. There were no marked differences between the degeneration and regeneration processes in the animals irradiated with the dose of 500 R to the head and those given the whole-body dose of 200 R. (BBB)

48194 INCIDENCE OF VIRUS DISEASES IN ASEPTICALLY-GROWN SILKWORM, BOMBYX MORI L. 2. EFFECT OF FEEDING OF CHEMICALS AND IRRADIATION OF GAMMA-RAYS. Kurata, Keiji (Sericultural experiment Station, Tokyo). Norinsho Sanshi Shikenjo Hokoku, 23: 149-71(Nov. 1968). (In Japanese).

Studies on the incidence of polyhedrosis caused by feeding of some chemicals or irradiation with γ rays to aseptically grown silkworm are presented. Throughout the present study, larvae were individually reared after inoculation of polyhedrosis viruses. The inoculation was performed by feeding the viruses with the diet for 24 hr. Chemicals used for the induction test were as follows: Na-EDTA, EDTA, NaF, NaCN, hydroxylamine, and formalin. Cobalt-60 was used as source of γ rays. Irradiation with γ rays was carried out on the first day of the fifth instar prior to the feeding. Many semi-pupae occurred in the case of the irradiation experiments. It seems that burn from γ rays was the cause for semi-pupae. The first and second instar larvae were inoculated with nuclear polyhedrosis virus (NPV) and cytoplasmic polyhedrosis virus (CPV) respectively, and then the surviving larvae were treated with low temperature in combination with irradiation with γ rays in the fifth instar stage. Polyhedrosis occurred neither in the treated larvae nor in the control, when the larvae were inoculated with NPV in the first or second instar and with CPV in the first instar stage. In the larvae inoculated with CPV in the second instar stage, no difference was observed in the rate of polyhedrosis between the treated and untreated groups. It was confirmed that the feeding of chemicals or irradiation of γ rays caused an increase in susceptibility of larvae to virus infection. Thus, the incidence of polyhedrosis in larvae by the feeding of chemicals or the exposing to γ rays is due to the microinfection by polyhedrosis viruses after the treatments and the provocation of the latent infection with CPV in the fourth instar stage into the acute infection by the feeding of chemicals. (NSA of Japan)

48195 EFFECTS OF IRRADIATION ON THE EGGS OF ADZUKI-BEAN WEEVIL, CALLOSOBRUCHUS CHINENSIS L. (COLEOPTERA: BRUCHIDAE). Kumagai, Momozo (Keio Univ., Tokyo). Appl. Entomol. Zool., 4: 9-15(Mar. 1969).

The eggs of the adzuki-bean weevil, Callosobruchus chinensis L., were irradiated with ^{60}Co with different doses ranging from 100 to 102,400 rad. The eggs used were from 2 hr to 6 days old. The data revealed that the radiosensitivity was not necessarily in direct proportion to the age of the eggs. The 8 hr-old eggs were the most radiosensitive and the 5 day-old eggs were the most resistant to the radiation. In all the test series of younger eggs less than 2 days old, no egg was hatched when it was irradiated with doses of more than 1,600 rad. In the tests with older eggs more than 3 days old, radiosensitivity decreased, and 5 and 6 day-old eggs showed

fairly good percentages of hatchability even when they were irradiated with a dose of 25,600 rad. The emergence of adults from these irradiated eggs was found to be checked when they were irradiated with a dose of 3,200 rad. Some adults emerging from 3 to 6 day-old eggs that were irradiated with a dose of 1,600 rad were found to be sterile. (NSA of Japan)

Vertebrates

Refer also to abstracts 47682, 47941, 47946, 47954, 47958, 47962–47964, 47966, 47969, 47978, 47981–47985, 47987, 47990, 47992–48003, 48007, 48022, 48045, 48083, 48086, 48087, 48165, 48166, and 48169.

48196 (AD-687081) RESPONSE OF A SPECIFIC GLUCOCORTICOID-MEDIATED GLYCOPROTEIN (α-2-GP) TO IRRADIATION INJURY. Bogden, Arthur E. (Mason Research Inst., Worcester, Mass. Dept. of Immunology). Dec. 1968. Contract F41609-67-C-0064. 26p. (SAM-TR-68-131). CFSTI.

Use of a monospecific antiserum reagent permitted detection and quantitation of an alpha-2 glycoprotein (alpha-2-GP) in the serum of rats subjected to increasing doses of whole-body x irradiation. It was found that irradiation injury induced synthesis of this specific glycoprotein macroglobulin, serum alpha-2-GP levels showed a dose-response relationship, and cortisol administration following irradiation had an enhancing effect on alpha-2-GP response. Tissue injury resulting from x irradiation appeared to evoke the same mechanisms of alpha-2-GP response as physical or chemical forms of trauma. Results of a preliminary probe indicated that the apparent dose rate effects may be a reflection of restraint stress with resultant response variations due to endogenous glucocorticoid release. Ancillary studies, designed to use the alpha-2-GP response as an indirect measure of the humoral factor (designated HIS) responsible for initiation of hepatic synthesis of alpha-2-GP, revealed that serum prepared from normal, nontraumatized animals, in contrast to plasma from the same source, could stimulate hepatic synthesis of alpha-2-GP when administered to normal, nontraumatized animals. The rationale for utilizing HIS release as a biodosimeter for estimating irradiation injury is discussed. (auth)

48197 (BMwF-FBK-69-16) ACUTE ALTERATIONS IN THE CEREBRAL MEDULLA OF MONKEYS AFTER TREATMENT WITH X RAYS. AN ELECTRON MICROSCOPIC STUDY. Cervos-Navarro, J.; Bergeder, H. D. (Bonn Univ. (West Germany)). May 1969. 52p. (In German). Dep.

The morphology of the brain edema after irradiation although of short duration is of special interest for the understanding of irradiation effects because of its early development. The present article is a contribution to the discussion about the formal genesis of the brain edema. The parietal cerebral medulla of 14 rhesus monkeys was studied with an electron microscope after irradiation with x-rays. Ten animals served as controls. In all controls an extracellular space of the medulla was found, which had a variable size depending on the mode of fixation. The extracellular space of the irradiated monkey brains increased already 6 hours after irradiation and reached its maximum after 48 hours. Six days later it decreased again. Differences with regard to the edematose changes were only quantitative. Only in one case where the enlargement of the extracellular space was extreme was it filled with a material of intense electron microscopic density. (auth)

48198 (NYO-2740-6, pp 235-7) RBE STUDIES WITH MONOENERGETIC NEUTRONS. OPACIFICATION STUDIES. Bateman, J.; Rossi, H. H. (Columbia Univ., New York. Radiological Research Lab.).

Data from a series of studies on optic lens opacification resulting from exposures of mice to 250 Kvp x rays or fast neutrons of 0.43, 1.80, or 14 MeV energy were analyzed. Similar RBE values were found for both anterior and posterior subcapsular regions of the lens under all conditions tested. The relation of RBE to dose decreased with increasing MeV values. Opacifications were indistinguishable from those observed in old unirradiated animals. Recent studies on opacification in mice as a function of age at the time of x-irradiation have helped to clarify the relation of radiation-induced opacification to that occurring normally in aging mice. (E.R.B.)

48199 (NYO-2740-6, pp 319-26) NOTE ON THE RADIATION RESPONSE OF SYSTEMS THAT ARE INACTIVATED IN ASSOCIATED ABSORPTION EVENTS. Rossi, H. H. (Columbia Univ., New York. Radiological Research Lab.).

A consideration of the RBE of 0.43 MeV neutrons relative to 14.7 MeV neutrons in the induction of opacities of the murine lens has indicated that it is impossible to account for the observed values of 8 or more on the basis of conventional inactivation models. A mechanism was postulated in which inactivation occurs as a result of energy deposition in (a minimum of) two sites that are in a definite geometrical relation to each other such that they can not only receive the required energy by two separate particles but also as a result of a double traversal by a single high LET particle. The mathematical derivation of this mechanism is presented. (E.R.B.)

48200 (NYO-2740-6, pp 345-73) RADIOBIOLOGY. Rugh, R. (Columbia Univ., New York. Radiological Research Lab.).

Studies were conducted to determine the differential response to x irradiation of fetuses and adults using mice. In one study, whole-body x irradiation of pregnant mice (15 days gestation) responded differently from the 15 day fetus in relation to erythrocyte and platelet counts. In all cases, complete recovery was evident by 3 weeks after birth. In another study, pregnant mice were exposed to 10, 15, 25, and 50 R x rays 1 to 12, 18, 24, and 30 hrs after insemination. There resulted a statistically significant reduction in the number of implantations following exposure to either 25 or 50 R of 6 to 8 hr zygotes. There was also a significant decrease in the percentage of normal implantations at the age of 7 hr post conception even in the 10 R series; at 6, 7, and 8 hr in the 15 R series; at from 5 to 10 hr in the 25 R series; and from 2 to 11 hr in the 50 R series. Investigation of the effects of the exposure of the embryo or fetus to x irradiation prior to the onset of skeletal development revealed that the greatest decrement occurred when the 15 and 16 day fetuses were exposed. Lesser decrements in skeletal development occurred in the 13 and 14 day fetuses. In a similar experiment, monkeys were exposed to 25, 50, 100, 200, and 400 R x rays during the second half of pregnancy. Radiographic and biochemical analysis of leg bones from the fetuses revealed no definite abnormalities at 100 R, and only transient arrest of bone growth at 200 R. However, 35 days following 400 R exposures, the epiphyseal structure was disrupted, the bones were hypermineralized, and the alkaline phosphatase activity was reduced. Current investigations, for which final results are not available, include: factors in the predisposition of organisms to cataracts following x irradiation; the all-or-none effects of radiomimetic drugs in the 8 day mouse fetus; the cytological effects of low dose x irradiation in the pre-cleavage mammalian embryo; the threshold dose of x rays for certain congenital anomalies in embryos and fetuses exposed at different gestational periods; the collection of literature for a review of the morphological effects of radiation on fetuses, and analysis of chromosome irregularities in x-irradiated fetuses following exposure at different gestation stages. (E.R.B.)

48201 (TID-25195) VISUAL CELLULAR STIMULATION BY HIGH ENERGY QUANTA. A Comprehensive Report, 1967–1969. Dawson, William W. (Florida Univ., Gainesville. Dept. of Ophthalmology). Contract AT(40-1)-3599. 17p. Dep. CFSTI.

A review of previous research by other investigators led to the conclusion that x-ray responsiveness is dependent more upon configuration aspects of neuronal organization than on the presence or absence of photopigment and its bleach product. Objectives of present research are to determine the particular retinal layers and cellular elements whose functions are altered or activated by low dose pulses of ionizing rays to account for the fact that people can see x rays on their products. A second goal was the application of ionizing rays to the measurement of retinal scotomata. A third goal was to test the effectiveness of physiologically equated x ray and visual stimuli in a simple eye. It was then proposed that findings from the above objections would be incorporated into a generalized theoretical structure which would account for visual excitation by ionizing rays and would also shed knowledge on the excitability of central nervous tissue by ionizing rays using the retina as a model tissue. Progress towards these goals consisted of development of tools for identification of those retinal cells that are excited by x rays. (H.L.W.)

48202 (UR-49-1137) RESPONSE OF UPPER-BODY X-IRRADIATED BEAGLE DOGS TO EXERCISE STRESS. Martinedes, Barbara Ann (Rochester Univ., N. Y. Dept. of Radiation Biology and Biophysics). 1969. 100p. Dep. CFSTI.

Thesis.

The response of upper-body x-irradiated beagle dogs to exercise stress, provided by 20-minute treadmill runs at 5 mph and a 7° grade, was examined. Six animals were given 1500R upper-body x-irradiation (bilateral midline air exposure, 55–60R/min, 1000 kVp, 3 mA), and six were sham-irradiated. After exposure or sham-exposure, three animals from each group were placed on a conditioning schedule consisting of 20-minute treadmill runs at 3 mph and a 0° grade three times a week. The remaining six animals were restricted to normal cage activity for 12 weeks until the period of stress testing began. Under these irradiation conditions and through the first 21 weeks after exposure, conditioning rather than

radiation exposure was revealed as the determining factor in the response to exercise stress. It is suggested, however, that unconditioned irradiated animals may be requiring more energy to maintain the exercise state. Evidence supporting this suggestion was supplied by pre- and post-exercise data on blood lactate, CO_2 and phosphorus and on heart rates taken before and during stress. Little change was observed in the maintenance of the electrolyte balance or in the serum glutamic oxalacetic or serum glutamic pyruvic transaminase levels. This investigation was designed to indicate, as prelude to more intensive study, those areas of physiological function which might be altered by sub-lethal upper-body x-irradiation. It is suggested that energy production in the muscle, with the attendant need to supply O_2 and remove CO_2, be examined more closely. (auth)

48203 PROTECTIVE EFFECT OF CYSTAMINE ON THE INDUCTION CAPACITY OF THE IRRADIATED EYE. Popov, D. V. (Moscow State Univ.). Vestn. Mosk. Univ., Biol., Pochvoved., No. 1, 110-11(1969). (In Russian).

Experiments on tadpoles showed that even small doses of ionizing radiation (300 to 400 R) impaired the normal course of eye development and that doses of 700 R or more rendered the eye incapable of inducing the cornea in grafted skin. Experiments on Rana temporaria tadpoles, showed that irradiation (700 R) delayed their general development by eight days, whereas the administration of cystamine (0.5% solution) largely normalized the development of the irradiated animals. Moreover, while irradiation completely suppressed the induction capacity of the eye, cystamine protected it. (JPRS)

48204 SKIN TUMOR INCIDENCE IN CBA MICE GIVEN FRACTIONATED EXPOSURES TO LOW-ENERGY BETA PARTICLES. Hulse, E. V.; Mole, R. H. (Medical Research Council, Harwell, Eng.). Brit. J. Cancer, 23: 452-63(June 1969).

The skin of 240 female CBA/H mice, three months old, was irradiated for various periods with a 1×8 cm ^{204}Tl source. The β irradiation had a relatively low maximum energy of 0.765 MeV so that the germinative layer of the epidermis received 69 to 72% and the dermis 40 to 70% of the dose. Thus a 12,000-rad dose was taken to be equivalent to an epidermal dose of 8400 rad and a dermal dose of 6600 rad. The total nominal dose to a zone was either 12,000 or 6000 rad. The number of fractions and the overall duration of exposure varied. Permanent epilation of the whole irradiated zone occurred in all mice receiving a nominal dose of 12,000 rad. With 6000 rad, however, complete epilation was reduced in frequency when the total dose was given in 4 equal fractions and did not occur at all when there were 12 or 20 fractions. When 12,000 rad was given in 4 fractions of 3000 rad 4 weeks apart, moist desquamation was visible at the time of the second and third exposures. No delayed ulceration of the skin occurred. A total of 98 skin tumors was seen, all in irradiated skin; of epidermal tumors, 34 were squamous cell carcinomas and one a highly keratinized sessile papilloma. Of the dermal tumors, all seven benign tumors were fibromas (three contained bone) and 54 malignant tumors were fibrosarcomas, most well differentiated (two contained bone). Occasionally, the histological picture suggested that a fibroma later became malignant. The two other malignant dermal tumors were unusual, a hemangioendothelioma, and an osteosarcoma with widespread metastases. In seven mice two anatomically separate tumors developed in 1 irradiated zone. Two mice had a fibroma and a fibrosarcoma, two a fibroma and a squamous cell carcinoma, and two a fibrosarcoma and a squamous cell carcinoma. The mouse with the hemangioendothelioma also had a squamous cell carcinoma. In an eighth animal the superficial part of a neoplastic mass was a squamous cell carcinoma and the deeper part a fibrosarcoma. Tumor incidence was similar in various groups and, unlike skin injury, was not affected by protraction of the dose. Thus there was little or no correlation between tumor formation and skin damage. (BBB)

48205 MAMMARY GLAND NEOPLASMS AFTER FISSION NEUTRON IRRADIATION. Vogel, H. H. (Univ. of Tennessee, Memphis). Nature (London), 222: 1279-80(June 28, 1969).

Some studies are described using rats. In contrast to the effects of x and γ rays there was no apparent linear relationship between neutron dose and neoplastic incidence, and there was no significant difference in the percentage of rats showing at least one mammary tumor over the dose range from 10 to 250 R of fission neutrons. The relative biological effectiveness of fission neutrons appears to be very high, particularly at the lowest neutron doses, and the results may make desirable a re-evaluation of the RBE of neutrons. Experimental work at Brookhaven and Memphis is compared, both for x and neutron irradiation. (UK)

48206 CYTOLOGICAL DAMAGE PRODUCED IN THE MOUSE TESTES BY TRITIATED THYMIDINE, TRITIATED WATER AND X-RAYS. Lambert, B. E. (Radiological Protection Service, Sutton, Eng.). Health Phys., 17: 547-57(Oct. 1969).

Irradiation of the mouse testes was carried out using internally distributed tritium from injected tritiated thymidine and tritiated water and also using external whole body irradiation with 200 kVp x-rays. The inability of intermediate spermatogonia to divide twice and produce resting primary spermatocytes was used as a criterion of biological damage, and the following conclusions were reached:— Injected amounts of both tritiated thymidine and tritiated water equivalent to less than 2 μCi/g body mass produced cell death in the testes; Tritiated thymidine was four times more effective in killing spermatogonia than equivalent injected amounts of tritiated water; For the same total dose of 200 kVp x-rays to the whole body, acute irradiation (dose rate 1.6 rads/min) delivered in less than 30 min, was more effective for cell lethality than irradiation at low dose rates (<0.7 rad/hr) spread over 72 hr. 5 μCi ^{3}HTdR injected/g body mass, 20 μCi tritiated water injected/g body mass, and 30 rads to the whole animal from 200 kVp x-rays delivered at an exponentially decreasing dose rate similar to that obtained from the two tritiated compounds, produced equivalent cell death within the testes over 72 hr. The RBE of tritium as tritiated thymidine or tritiated water relative to 200 kVp x-rays was found to be in the range 1.3–2.4. (auth) (UK)

48207 METHOD OF INVESTIGATING COMPONENTS OF NON-SAPONIFIABLE FRACTION OF RAT SKIN IRRADIATED WITH ULTRA-VIOLET LIGHT. Datsenko, Z. M. (Inst. of Biochemistry, Kiev). Ukr. Biokhim. Zh., 41: 330-4(1969). (In Ukrainian).

A method is worked out for quantitative and qualitative determination of component of non-saponifiable fraction of rat skin. By means of the described method the composition of non-saponifiable skin fraction of animals irradiated and non-radiated with ultraviolet light was investigated. (auth)

48208 EFFECT OF INHALATION AFFECTION OF RABBITS BY PLUTONIUM ON CHEMICAL COMPOSITION OF BLOOD. Mushkacheva, G. S.; Tseveleva, I. A. (Inst. of Biophysics, Moscow). Ukr. Biokhim. Zh., 41: 306-10(1969). (In Ukrainian).

The content of total protein, protein fractions, hexosamine, and sialic acids was studied in blood serum of rabbits in the process of experimental pneumosclerosis development provoked by momentary inhalation of ammonium plutonium pentacarbonate. It was found that during early periods after plutonium inhalation the content of hexosamine considerably increased (in two weeks—by 29%; in a month—by 109% in comparison with control). Disproteinemia observed was not sharply pronounced, but intensified in the late periods of inhalation. Possible mechanisms for the mentioned changes and their relation to the development of the pneumosclerous process are discussed. (auth)

48209 EFFECTS OF PROTON AND ROENTGEN RADIATION ON THE RECTUM OF THE RAT. Stenson, Stig (Uppsala Univ. Univ. of Umea, Sweden). Acta Radiol., Ther., Phys., Biol., 8: 263-78(Aug. 1969).

A segment of the rat pelvis was irradiated with high energy protons or x rays. The ability of the two types of radiation to evoke damage of the rectum was compared by gross and microscopic examination eight days to one year later. The results indicate that the two types of radiation create the same type of damage but that the protons seem to be slightly less effective. (auth)

48210 THE RBE OF FAST NEUTRONS AND THEIR TISSUE-EQUIVALENCE DOSIMETRY. Graul, E. H.; Krueger, H.; Ruether, W.; Piroth, D. (Philipps-Univ., Marburg, Ger.). pp 899-906 of Progress in Radiology. Vol. I. Turano, L.; Ratti, A.; Biagini, C. (eds.). New York, Excerpta Medica Foundation, 1967. (In German).

From 11th International Congress of Radiology, Rome. See CONF-650907-(Vol.1).

A Plexiglas tube apparatus for delivering simultaneous doses of whole-body radiation to mice and rats is described. Methods of dose determination are discussed. A logarithmic scale graph is given to show the qualitative depth dose curve for different primary neutron energies. The RBE for γ and neutron lethality effects on mice and rats was determined. A graph is presented to show comparisons of per cent weight change in mice following γ and neutron radiation. Regeneration and residual damage following γ and neutron radiation are discussed. The RBE values for γ and neutron radiation effects on mouse testes, cataracts in rabbits eyes, and HeLa cells are presented. (H.L.W.)

48211 A REPLY TO THE PRECEDING CRITICISM BY SMITH AND DIMOND. McDowell, A. A.; Stolmeier, P. V. J. Genet. Psychol., 115: 75-6(Sept. 1969).

A reply to a criticism of a previously published paper on effects of radiation on fearfulness in rats is presented. It is pointed out that results with respect to a particular test in terms of emotion-

ality should not be interpreted unless results over a battery of tests presumed to affect emotionality are consistently similar or physiological correlates of the test support the interpretation. (H.L.W.)

48212 CRITICISM OF THE STUDY BY MCDOWELL AND MERCHENT ON FEARFULNESS IN CONTROL AND IRRADIATED RATS. Smith, Howard; Dimond, Stuart J. (University Coll., cardiff, Wales). J. Genet. Psychol., 115: 71-3(Sept. 1969).

A previously published paper on effects of radiation on fearfulness in rats, using as measures of fearfulness the time taken for animals to emerge from a tunnel into an open field, is criticized. It is pointed out that the effect of conditions of stress, hypoxia, and irradiation during pregancy acts to reduce the level of activity in the open field. The paper is also criticized from the standpoint that control procedures are not adequate. (H.L.W.)

48213 CHANGES IN SERUM AND TISSUE TRANSAMINASES IN ANIMALS IRRADIATED WITH RADON. Pegel, V. A.; Dokshina, G. A.; Borovikova, G. V. (Tomsk State Univ., USSR). Biol. Nauki, No. 2, 52-7(1969). (In Russian).

The effects of intraperitoneal injection of radon (52 ber) on aspartate- and alanineaminotransferases were studied in the liver, kidneys, and spleen of rats. The changes noted in the activity of the serum and tissue transaminases after 2, 4, 6, 24, and 48 hr were indicative of a marked lack of coordination in the transamination processes catalyzed by alanine and aspartate aminotransferases. The impaired coordination of the two enzyme systems is ascribed to a breakdown of endocrine regulatory mechanisms responsible for the enzyme balance in blood serum and other tissues. (JPRS)

48214 RADIATION EFFECTS AND RECUPERATIVE PROCESSES IN LYMPHOID TISSUE OF THE THYMUS AND LYMPHATIC NODE OF RATS AFTER INCORPORATION OF ^{144}Ce. Khussar, Yu. P.; Tokin, I. B. Dokl. Akad. Nauk SSSR, 185: 1368-71(Apr. 21, 1969). (In Russian).

White rats were given a single, intraperitoneal dose of 100 microcuries of ^{144}Ce, and then were killed at 1, 2, 4, 7, 14, 60, and 180 days later along with control animals. The thymus and lymphatic nodes were fixed with 10% neutral formalin. Paraffin slices 7 microns thick were stained with hematoxylin-eosin, azure II-edsin, and iron hematoxylin. The mitotic coefficient and percent of pathological mitoses were calculated from a determination of the number of mitoses per 6000 cells. Considerable damage to the cellular constituents (deformation of nuclei, pycnosis, vacuolization and cell breakdown) was observed over the entire period, especially at 1 to 7 days after introduction of the radioactivity. These changes were accompanied by a massive separation of lymphocytes. In about half the cases the reactive centers of the lymphatic node disappeared (nodule-free period). The dimensions of the thymus decreased by a factor of 2 to 3, and the cortex of the lymphatic node by a factor of 2. The mitotic activity of the lymphocytes was sharply depressed at 4 days, and then at 60 days after administration of the ^{144}Ce. The mitotic activity was established again at the end of 6 months at a significantly higher level than the initial one. This behavior can be considered as a precancerous state of the lymphoid tissue. Further supporting evidence for a cancerous condition is that the number of pathological mitoses in the irradiated animals is 100% compared to only 2 to 4% of all the mitoses in the control animals. (TTT)

48215 CIRCULATION OF LYMPHOCYTES IN THE GOAT: TIME FOR PASSAGE OF LYMPHOCYTES FROM THE BLOOD TO THE EFFERENT POPLITEAL LYMPHATICS AND INCIDENCE OF EXTRACORPOREAL ULTRAVIOLET IRRADIATION ON THIS CIRCULATION. Villeneuve, B.; Binet, J. L.; Becart, Renee; Bernard, Jean (Hopital Saint-Louis, Paris). Nouv. Rev. Franc. Hematol., 8: 535-9(Sept.-Oct. 1968). (In French).

Cannulation of the popliteal efferent lymphatic vessels in the goat permitted measurement of the cellular and lymph output from this efferent lymphatic. A transit time of lymphocytes from the blood to the popliteal lymphatic efferent of less than 1 hr was recorded. The disappearance of ^{3}H-thymidine-labeled lymphocytes from the circulating blood in the uv-irradiated goat is marked. High efficiency of extracorporeal uv irradiation (no details of uv irradiation given, but injury to lymphocytes implies wavelength of 2537 Å used) of the selective destruction of lymphocytes is predicted. Irradiation for just a few minutes resulted in almost complete disappearance of ^{3}H-labeled lymphocytes from the peripheral blood and lymph nodes. (BBB)

48216 EFFECT OF LONG-TERM LOW IRRADIATION ON THE MAMMAL ORGANISM. II. RETURN OF BLOOD VALUES TO NORMAL AND REACTION TO REPEATED RADIATION. Semenov, D. I.; Borisova, N. D. Tr. Inst. Ekol. Rast. Zhivotn., No. 57, 25-30(1967). (In Russian).

Tests with repeated courses of radiation exposure were conducted in 19 rabbits divided into three groups and exposed daily for 15 hr to 20 R γ rays until a dose of 800, 1500, or 3000 R was reached. Hematic changes and weight were monitored. After this treatment the animals were given a rest of 2, 4, and 8 months respectively under further monitoring of blood and weight that showed an apparent return of these values to normal, and then subjected to another course of radiation treatment. Results are shown for four such courses. Great variations in resistance were observed. Most animals died before completion of the four courses of treatment; three animals from the 1500 R and one from the 3000 R group proved most resistant (death after 5000 to 6000 R). Leukopenia (e.g., in the first group leukocytes dropped from 13,200 to 4100/cc) was reversed after two months when leukocytes again reached 12,500, but after the next treatment 2 months proved insufficient for return to normal, and the animals started the third course of treatment with 8500 leukocytes/cc. Particularly in the two groups subjected to higher irradiation, leukocytes also increased for a short while during subsequent treatments, then dropped once more. Erythrocytes decreased gradually during irradiation and returned to normal during the rest period, but return again took longer for each course of treatment. Weight changes also showed individual variation. The group subjected to 1500 R showed least sensitivity in this respect. It was concluded that daily γ irradiation with 20 R ^{60}Co for a total of 700, 1500, and 3000 R caused blood and weight changes in rabbits; these changes were apparently reversed during rest, but the number of leukocytes rarely reached initial values. Each repeated course of treatment at the same doses had a more pronounced effect. Hence, full reversal may be assumed to take a rather long time. However, even at massive total doses (3000 R) apparent reversal of blood indices and recovery may occur. (JPRS)

48217 EFFECT OF LONG-TERM LOW IRRADIATION ON THE MAMMAL ORGANISM. III. EFFECT OF FRACTIONAL DOSES ON RADIATION REACTION. Semenov, D. I.; Borisova, N. D. Tr. Inst. Ekol. Rast. Zhivotn., No. 57, 31-42(1967). (In Russian).

Hematic reactions and weight change were studied in 40 young rabbits and eight dogs exposed to γ rays for 1 yr at two summary doses of 365 R (group A), and 1825 R (5 times that dose, group B). These doses were given in three variants: 1 R and 5 R daily (A_1 and B_5); 2 R and 10 R daily for two weeks with a two weeks rest interval (A_2 and B_{10}); and, one irradiation of 91 R (A_{91}) and 456 R (B_{456}) every 3 months. Weight and hematic condition were checked every 2 weeks. Highest rabbit mortality in the A group was determined for the daily 1 R dose, in group B for the 5 R, and for the 3-month irradiation with 456 R. Out of groups A_2 and B_{10} only 2 rabbits from the latter group died, and only one of the A_{91} died long after the test. In the groups with low mortality, A_1, A_{91}, and B_{10}, weight gain was satisfactory while hardly any weight gain was recorded for the others. In blood tests, leukocyte changes were about the same for A_1 and A_2, except for a smoother curve in the 1 R group. Curves for the 3-monthly radiation treatment showed sharp peaks and valleys corresponding to each exposure. Values were higher for B_5 than for B_{10}. While reticulocytes were completely irregular their number was rather high, even in pronounced anemia. Lymphocyte curves paralleled those of the leukocytes; pseudoeosinophils varied around normal, and cells with rod-shaped nuclei decreased slightly. In the survivors, the blood values returned rapidly to normal for 1 and 2 R doses; this took 18 to 20 days for the 5 and 10 R groups, but some animals lost weight and died later, while the number of lymphocytes decreased sharply shortly before death. Erythrocytes decreased insignificantly at the 356 R total dose while higher doses caused some decrease. The dogs tolerated this type of radiation better, and leukocytes decreased mostly only toward the end of the test. It was concluded that the poor correlation between mortality and hematic curves would indicate that blood values are poor indicators for damage in long-term irradiation. In these tests, hematic reactions were insufficient signs for changes due to radiation with 1 and 5, and 2 and 10 R. In long-term γ radiation, fractionated doses given at intervals were less lethal than daily doses for the same total dose. However, leukocytes dropped more sharply for fractionated doses. The degree of lymphoid damage seems to depend on the intensity rather than fractionation of the dose. Weight change in rabbits was a more sensitive indicator for radiation injury than the blood findings. Dogs were apparently more resistant to long-term low radiation than rabbits, in contrast to findings for the effects of massive short-term radiation. (JPRS)

48218 ELECTRON MICROSCOPIC STUDY OF THE RABBIT CILIARY BODY IRRADIATED WITH X-RAYS IN COMPARISON WITH RESULTS OBTAINED WITH FAST NEUTRONS. Mukai, Kenji (Hiroshima Univ.). Nippon Ganka Gakkai Zasshi, 72: 594-604(May 10, 1968). (In Japanese).

Forty-four eyes of 22 10-week-old albino rabbits were exposed

to 180 kV x rays (dose: 1,000 R and 2,000 R). The anterior segment of the globe and the optic media were observed by biomicroscope, while the ciliary body was studied by light and electron microscopes up to a maximum period of 10 weeks after irradiation. The results were compared with those obtained with the use of fast neutrons. The results were as follows: Of the 44 eyes, ciliary injection was noted in 29 during the earlier period after irradiation while floaters in the aqueous humor and deposits on the anterior surface of the lens were observed in all (44) eyes. Interstitial edema and hemorrhage were noted in all cases by 8 days after irradiation. Widening of the ciliary channel and intercellular space of the outer epithelial cell layer were noted in all cases by 8 days after irradiation. In one rabbit that was exposed to 1,000 R, there was a loss of the normal intracellular fine structures of the inner epithelial cells, and the cytoplasm presented a picture of being completely occupied by numerous inclusion bodies that were considered to be cytolysomes and small vacuoles. Such cells were found to be present among cells with normal findings. They had lost infoldings and interdigitations of the plasma membrane and it was believed that they also lacked the normal functions of ciliary body epithelial cells. The ciliary bodies of all eyes exposed to x-rays or fast neutrons developed inflammatory reaction in the stroma during the earlier period following irradiation, and with the elapse of time results showed that this could cause retrograde degeneration of the epithelial cells. There was a quantitative difference, but no qualitative difference. The inflammatory reaction of the ciliary body stroma was markedly greater among the group whose eyes had been exposed to x rays, similarly changes in the anterior segment of the globe were also greater among an x-ray exposed group. On the other hand, the latent period of lenticular changes following irradiation was shorter for a fast neutron exposed group and the degree of lenticular opacities present 4 to 10 weeks after irradiation was also greater in this group. Although ciliary body disturbances induced by x ray or fast neutron irradiations have secondary effects upon the development and progress of lenticular changes, it is felt their degree of importance is small. (auth)

48219 ON THE PROBLEM OF THE COURSE OF THE REGENERATION PROCESS IN IRRADIATION APLASIA OF THE BONE MARROW. Kraevskii, N. A.; Afrikanova, L. A. Arkh. Anat., Gistol. Embriol., 52: 22-33(June 1967). (In Russian).

The acute period of injury and initial stages of regeneration in the course of progressing irradiation aplasia of the bone marrow was studied with the help of histological investigation of sections of spongy and tubal bones, combined with evaluation of a general number of nuclei-containing elements in the femoral bone of animals. The study was performed on 115 guinea pigs; 100 of them were subjected to irradiation (apparatus EGO-2 dose of 300 R). The material was investigated at various periods from 2 hr to 15 days following the exposure. Under conditions of the present experiments the maximum development of aplasia of the bone marrow was observed on the 10th day, when the general number of the nuclei-containing elements constituted only 10% of the control level. The development of aplasia was definitely determined during the first three days with simultaneous mass death of the cells of the hemopoietic tissue. During the first 24 hr early necrobiosis of the young forms of the cells of the red and white rows, as well as of lymphocytes was present. Within the first one to three days there was noted disintegration of the mass of cells ready to pass into the peripheral blood (erythrocytes and mature granulocytes). Mass death of the cells of the hemopoietic tissue occurred against the background of alterations observed in the sinuses of the bone marrow. Development of a very distinct total dilatation of the sinuses of the bone marrow accompanied with early hemorrhages into the bone marrow tissue was observed during the first 24 hr after the exposure. Some signs of regeneration originating in the bone marrow were revealed already in the course of the progressing aplasia, however this regeneration could not ensure any effective restoration of hemopoiesis during the first one to ten days. The period of true restoration of hemopoiesis commenced only after 10 days. Its onset was characterized by hyperplasia of the reticular tissue in the region of endosteum and around the adipose cells. At the very beginning of regeneration of hemopoiesis, the erythropoiesis was topographically separated from myelopoiesis. (auth)

48220 CHANGES OF ARTERIAL PRESSURE AND EXTERNAL RESPIRATION IN ANIMALS IN CONNECTION WITH THE EFFECT OF AN ULTRAHIGH-FREQUENCY (MICROWAVE) ELECTROMAGNETIC FIELD. Komarova, L. A. (State Inst. for Advanced Training of Physicians, Leningrad). Vop. Kurortol., Fizioter. Lech. Fiz. Kul't., No. 6, 503-6(1968). (In Russian).

In 72 acute experiments on cats arterial pressure, pressor vascular reflexes and external respiration were studied when a microwave field of various doses (0.4 and 0.13 watt per square centimeter) was applied for 10 minutes to the head region (dorsal surface), stomach region, and the anterior surface of the animal's neck. The greatest changes in arterial pressure, pressor vascular reflexes and external respiration were observed when the dorsal surface of the head was exposed to the microwave field. Irradiation of the anterior surface of the neck and the region of the stomach with 0.4 watt per square meter produced no change in arterial pressure in the first 5 minutes of exposure and a moderate increase thereafter. Exposure at this dose of the neck surface and stomach region showed no change in external respiration. It was assumed that the changes caused by exposure of the head region to the microwave field occurred by and large because of excitation of the receptors of the skin and soft tissues located in the zone of exposure. However, given the penetrating effect of microwaves 4 to 5 centimeters into the tissues and the great intensity of irradiation, the direct effect of the ultrahigh-frequency field on the brain could not be excluded. (JPRS)

48221 A METHOD OF VISUAL EVALUATION OF THE EFFECT OF AN ULTRAHIGH FREQUENCY FIELD ON THE ORGANISM. Sevast'yanov, V. V. Voenno-Med. Zh., No. 1, 54-5 (1969). (In Russian).

The stain used to show the effect of an uhf field on the rabbit was a one-percent aqueous solution of Trypan blue, that was injected with a syringe into a vein of the ear of a rabbit. The dose was 1 ml of solution per kilogram of the animal's weight. After 30 minutes the rabbit's hip was exposed to the local effect of an UHF field. On the day before the experiment the fur was removed with a depilatory from the part of the hip exposed to the treatment. The treatment was given with a physical therapy apparatus with a cylindrical contact electrode (diameter 35 millimeters). The outline of the emitter was marked in India ink on the hip. If motor reactions were manifested in the animal, the exposure time was recorded and the treatment was terminated. Numerous experiments in this type of contact irradiation showed that doses of more than 6 to 8 watts and exposure of more than 10 minutes formed clearly distinguishable areas of intense staining at those places which were subjected to the strongest irradiation. Because the structure of the beam was not homogeneous, the location and configuration of these areas of the body corresponded precisely to distribution of the energy. Photographs indicate this clearly. (JPRS)

48222 LATE CHROMOSOMAL LESIONS IN DOGS IRRADIATED AND RESTORED BY AUTOGENETIC BONE MARROW OR SPLENIC CELLS. Costaechel, O.; Corneci, I.; Andrian, T.; Popescu, N. C.; Encut, I.; Liciu, Florentina (Oncological Inst., Bucharest). Atomkernenergie, 14: 358-62(Sept.-Oct. 1969).

Mongrel dogs were teleirradiated in toto, one to three times, by single doses of x rays (600 to 1000 rad) and restored after each irradiation by transfusion of autogeneic bone marrow or splenic cells. At variable intervals (up to 19 months) after each restoring the medullary cells karyotype of these dogs in comparison with those of non irradiated control dogs was studied. In irradiated animals restored by the two types of autogeneic cells, modifications consisting of a high number of aneuploid cells and also morphological chromosomal aberrations were found persisting after a long time. Lesion frequency for the same time interval was higher in animals that had been repeatedly irradiated and restored. Mechanisms of chromosomal aberrations are explained by: repopulating of the hemocytopoietic tissues by host surviving cells after irradiation, intercellular transfer of nuclear material damaged by irradiation or indirect radiobiological effect. Genetic implications of using bone marrow obtained from irradiated donors, as means of preventing secondary immune syndrome, are discussed. (auth)

48223 RADIATION DAMAGE TO BULL SPERM MOTILITY. I. X-RAY EFFECTS AND TARGET THEORY. van Herpen, Gerard (Univ. of Utrecht); Rikmenspoek, Robert. Biophys. J., 9: 822-5(June 1969).

Dose response curves for the damage of bull sperm motility by x rays were determined and target theory was adapted to sperm motility to estimate the volume of the element primarily sensitive to irradiation. Bull semen samples diluted with Krebs–Ringer solution were irradiated with 180-kV x rays at 4°C to doses up to 24 KR. Dose response curves were measured for the survival fraction of the spermatozoa, and for the average velocity of the surviving cells. The dose response curves did not show a sensitivity threshold. The half-value dose was determined as 11 KR for the survival fraction and 10 KR for the average velocity. Target theory, adapted to explain the form of the measured dose response curves, indicated that a small sensitive element is present in the sperm cell with a volume of about $0.7^5 \times 10^{-15}$ cm^3. (BBB)

48224 AN APPROACH TO DOSIMETRY IN EMBRYONATED CHICKEN EGG DURING IRRADIATION WITH INTERNALLY APPLIED RADIOISOTOPES. Koeteles, G. J.; Antoni, F.; Szabo, L. D. (Frederic Joliot-Curie National Research Inst. for Radiobiology and Radiohygiene, Budapest). Atomkernenergie, 14: 363-5(Sept.-Oct. 1969).

To elucidate the mechanism of the biological action of incorporated radiophosphorus ^{32}P in the chick embryo, the concentration changes of inorganic ^{32}P injected into 3-day old embryonated eggs were studied during embryonic development both in the embryo itself and in the extraembryonic parts. For the determination of the absorbed dose value, in addition to concentration, the value of escaping energy depending on the shape and size of embryos in various developmental phases was also determined by chemical dosimetry, in model experiments. Dose values calculated for various levels of ^{32}P suggest that β radiation and transmutation produce the biological effect jointly. (auth)

48225 INCORPORATION OF TRITIATED THYMIDINE INTO THE CYTOPLASM OF PAS POSITIVE RETICULAR CELLS IN X-IRRADIATED MOUSE THYMUS. Ueki, Ayako (Okayama Univ., Japan). Arch Histol., Jap., 30: 201-6(Feb. 1969).

The cytoplasm of Periodic Acid-Schiff (PAS) cells in x irradiated mice thymus was studied with autoradiographical and histochemical technics. Tritiated thymidine was incorporated into the cytoplasmic areas of PAS cells where a positive Feulgen's nuclear reactor was observed. The intensity of the nuclear reaction varied greatly; some cells were stained homogeneously whereas others showed the existence of granular DNA component in their cytoplasm. These cytoplasmic DNA components are probably derived from phagocytized thymocytes. Although their fate is unknown, their utilization by surrounding lymphocytes is most likely. (NSA of Japan)

48226 MASSIVE, SINGLE EXTRACORPOREAL IRRADIATION OF THE BLOOD OF THE RAT TO DOSES GREATER THAN 500,000 RAD. Pellerin, P.; Remy, M. L. (Service Central de Protection contres les Rayonnements Ionisants, Le Vesinet, France). Nouv. Rev. Franc. Hematol., 8: 657-72(Sept.-Oct. 1968). (In French).

Irradiation of circulating blood of 225 rats was performed with massive doses of the γ rays from a 1000-Ci ^{192}Ir source. After doses up to 300,000 rad, changes in the blood cell pattern and numbers were slight, and only became marked above 400,000 rad. High doses were well tolerated by the body, up to 700,000 rad. A 1,200,000-rad dose was reached in one animal that survived. The total anesthesia time lasted 3 hr, and the actual irradiation lasted 1 hr. Circulation was ensured by the animals own beating heart, so that injury of the blood cells by an auxiliary circulation device was eliminated. Of 225 rats so treated, 23 survived 4 months at least, and 97% of the deaths were attributable to prolonged anesthesia (Combutal). Systematic blood examinations were carried out for more than 4 months on animals submitted to the extracorporeal irradiation, on control animals (submitted only to anesthesia and blood shunting without irradiation), and on normal animals of the same age (not submitted to any experimentation). Massive irradiation caused in the red cell line an immediate anemia, the severity of which varied according to the dose, and which was, on an average, more than twice as great for doses of 700,000 rad than for the anemia from dilution of blood noted in control animals. This anemia disappeared within 2 months. All the elements of the white cell series showed a considerable decrease immediately after irradiation, followed by a leucocytosis reaching up to three times the normal level, on an average. This peak occurred within 5 days following irradiation. The average time for return to normal was less than 1 month. (BBB)

48227 SOME INDICES OF FERTILITY OF FEMALE MICE IRRADIATED WITH 10-CENTIMETER WAVES. Bereznitskaya, A. N. (Inst. of Industrial Hygiene and Occupational Diseases, Erevan). Gig. Tr. Prof. Zabol., No. 9, 33-7(1968). (In Russian).

The effect of 10 cm waves of low intensity (10 mw/cm^2) on the estrous cycle, fertility, and progeny of white mice weighing 20 to 22 g at the beginning of the experiment is reported. Animals were irradiated twice daily for 1 hr for 5 months. Body-weight loss was noted within 2 weeks after the start of irradiation; maximum loss occurred during the third and fourth months. There was little difference in the percentage of normal cycles in irradiated and nonirradiated mice after 5 months. Decrease in the reproductive function of the ovaries in irradiated animals was manifested by increased duration of the normal cycle, prolonged diestrus and metaestrus and shortened estrus. Fertility was studied in 113 irradiated and 58 control mice. During proestrus or early estrus, the animals were mated with nonirradiated males. Pregnant animals were divided into two groups; animals in group 1 were not irradiated during pregnancy; animals in group 2 were irradiated up to the 18th day of pregnancy. The percentage of conception in irradiated and control mice was 75% and 94%, respectively. Stillbirths and a significant number of weak, nonviable animals were noted in the litters born to females irradiated during pregnancy. There was a statistically significant retardation in body-weight gain and growth in the progeny of animals irradiated before and during pregnancy. (JPRS)

48228 EFFECTS OF LASER RAYS ON CERTAIN INTERNAL ORGANS. Khromov, B. M.; Korotkevich, N. S.; Oskova, E. E. (Leningrad Inst. for Advanced Training of Physicians. State Scientitic Research Psychoneurological Inst., Leningrad). Eksp. Khir. Anesteziol., No. 5, 12-18(1968). (In Russian).

The liver, spleen, and kidneys of rats were exposed to laser rays with an energy of 50 j. Scar tissue formed at the exposure site in the liver by the 17th day. Elsewhere the liver was hyperemic and small infiltrates were found along the pathway of the blood vessels. At the same time and with the same laser ray energy, the entire splenic pulse was hyperemic and at the exposure site could be seen scar tissue and a thickening of the capsule. Necrosis was evident in the kidneys by the 23d day, but scar tissue did not form until the 30th day. The necrotic area was largest in the liver, less so in the kidneys, and smallest in the spleen. Hemorrhages were most massive in the spleen, less so in the kidneys, and insignificant in the liver. These differences were probably due to the structural characteristics and blood supply of the organs. (JPRS)

48229 GROWTH, DIFFERENTIATION AND REGENERATION. 44. EFFECTS OF REPEATED X-IRRADIATION ON THE FORMATION OF THE EARLY TRITURUS EMBRYO. Ogawa, Yoshito (National Inst. of Genetics, Mishima, Japan). Igaku To Seibutsugaku, 76: 81-4(Feb. 10, 1968). (In Japanese).

Triturus pyrrogaster embryos at different stages of growth were subjected to a total x-ray dose of 400 R in either two 200-R doses at a 24 hr interval or a single 400 R dose to study the effect of the irradiation and age on the differentiation of protein components. The artificially fertilized embryos were separated into experimental and single-dose 400-R and 200-R control groups, subdividing them into groups depending on the time of irradiation following fertilization. At every 24 hr interval following irradiation the embryos were ground, centrifuged, and diluted. The diluted solutions were reacted with anti-actin rabbit serum to determine the time for actin appearance. Normal embryos not subject to irradiation showed actin formation after 132 hours. Embryos subjected to two separate 200 R doses 36 and 60 hours after fertilization showed actin appearance at 60 hr or just after the second irradiation, when the doses were given at 60 and 84 hr, and at 180 hr when the doses were administered after 84, 108, and 108, 132 hr. No further change in actin appearance occurred when the irradiation was made at later stages of fertilization. The 200 R control showed actin appearance at 60 hr for 36 and 60 hr irradiation; this value was 84 hr for the 400-R control. There was little evidence of any x-ray effect when the irradiations were made at a later stage. The results are interpreted to indicate that there was very little difference between single and repeated doses, and the recovery rate following irradiation was extremely rapid. (TTT)

48230 RADIO-FREQUENCY ELECTROMAGNETIC FIELD AS A HYGIENIC FACTOR. Dumanskii, Yu. D. (Inst. of General and Municipal Hygiene, Kiev). Vrach. Delo, No. 11, 101-3(1968). (In Russian).

With the knowledge that the strength of the electric field ranges from 3.2 to 0.1 volts per meter in residential and public buildings located 100 to 600 meters from a television antenna, the biological effect of this type of electric field was investigated in white rats in a chronic experiment (150 days), with field strength of 50, 15, 8, 4, and 0.4 volts per meter. The animals were exposed to the effect of the electric field 18 to 20 hours per day, which corresponds to the exposure of the population during the operation of powerful short-wave radio transmitters. In the experiment the electric field was created by a short-wave radio transmitter operating at a wave length of 42 meters. These conditions caused noticeable changes in the central nervous system of the experimental animals: cholinesterase activity decreased 23 to 68 percent within the first 30 days even with relatively low strength of the electric field (8, 4, 0.4 volts per meter); pronounced shifts in conditioned reflex activity were observed that indicated a change in the latent period for various conditioned stimuli, and these shifts in conditioned reflex activity increased with the length of exposure; changes in the thalamus-pituitary-adrenal system were indicated by a sharp increase in the content of 17-ketosteroids in the urine and the number of leukocytes, reticulocytes, and eosinophils in the blood decreased with length of exposure. A comprehensive hygienic study of populated areas near radio and television transmitters was recommended. (JPRS)

48231 THE EFFECT OF GAMMA RAYS (^{60}Co) AND ENDOXAN (CYCLOPHOSPHAMIDE) INJECTIONS ON SILICOTIC FIBROGENESIS IN RATS. Thiart, B. F.; Engelbrecht, F. M. (Univ. of Stellenbosch, S. Afr.). S. Afr. Med. J., 43: 118-19(Feb. 1, 1969).

Rats were injected intratracheally with a fine silica suspension and divided into three groups, A, B, and C. Group A served as the control. Group B received repeated Endoxan injections and group C was exposed to a γ radiation dose of 500 R. Injections of Endoxan and irradiation both caused a decrease in the total serum protein concentration as well as in the albumin and γ-globulin percentages. The circulating lymphocyte count and the cell population of the lungs of the Endoxan-treated and of the irradiated animals were consistently lower than those of the control animals. In spite of these changes, the total amount of pulmonary fibrosis was slightly higher in the irradiated and Endoxan groups than in the control group. Results showed no positive correlation between the amount of pulmonary fibrosis and concentration of γ-globulins in the serum. The results indicated that neither lymphocytes nor circulating γ-globulins are directly involved in silicotic fibrogenesis, and therefore do not support an immunological pathogenesis for silicotic fibrosis. (BBB)

48232 THE EFFECT OF FRACTIONAL IRRADIATION WITH BETATRON ON THE INTRAORGANIC LYMPHATIC VESSELS OF THE STOMACH AND SMALL INTESTINE. Chernova, V. A.; Boreisho, G. K.; Gurchenok, A. P. (Medical Inst., Tomsk, USSR). Arkh. Anat., Gistol. Embriol., 55: 133-6(1968). (In Russian).

Intraorgan lymphatic vessels of the stomach and intestines under conditions of irradiation sickness experimentally induced by fractionated irradiation from a 25 MeV betatron were investigated in 30 animals. The lymphatic and blood vessels were injected by a common technique. Clarified preparations were studied with stereomicroscope MBS-2. Acute irradiation injury caused enlargement of the lymphatic capillaries and draining vessels in all divisions of the gastrointestinal tract. However, changes in the intraorgan capillaries in different membranes of the gastric and intestinal walls were unequal. Dilatation of the capillaries, most seen in the mucous and submucous membranes was less in the serous and the least in the muscular ones. The blood vessels were dilatated and tortuous in all membranes of the gastrointestinal tract. Permeability of the walls of both the blood and lymphatic vessels was intensified; ruptures of the vascular walls were observed. Dilatation of the intraorgan blood and lymphatic vessels combined with high permeability of the vascular walls impaired hemodynamics and lymph circulation in the stomach and intestines of the animals subjected to fractional irradiation from the betatron. (auth)

48233 DATA FOR THE STUDY OF THE BLASTOMOGENIC ACTION OF IONIZING RADIATION OF THE TISSUE STRUCTURE OF THE CENTRAL NERVOUS SYSTEM. Dimant, I. N.; Abdurasulov, D. M.; Lokitionov, G. M.; Stolyarova, A. G.; Sataev, M. M. (Research Inst. of Roentgenology, Radiology, and Oncology, Tashkent). Arkh. Anat., Gistol. Embriol., 51: 61-70(Dec. 1966). (In Russian).

A review of radiation carcinogenesis in the tissues of the central nervous system and data on the problem were presented. The experiments were conducted on 10 rabbits and five dogs. The animals were subjected to implantation of ^{60}Co granules (activities of 15 and 30 μCi respectively) in the cerebral matter. To screen β-irradiation the granules were coated with a paraffin layer one mm thick. Within 258 to 430 days cerebral neoformations developed in five rabbits. Histologically they were tumors of the meningo-vascular type (four animals) and complex bidermal-type tumor derivated from mesenchyme and neuroectoderm (one animal). In two dogs, besides radionecrosis zones, there were focal polyfractional proliferates of the microblastoma type, resembling in their structure a stage of neoplasm formation. On the 815 day one dog exhibited an extensive tumor of non-differentiated malignant glioma type. Detained morphological and biological characteristics of the induced neoformations were also presented. (auth)

48234 COMPARATIVE STUDIES OF THE INFLUENCE OF VARIOUS ACTIVE SUBSTANCES OF THE VITAMIN B COMPLEX ON THE RADIATION SYNDROME IN RATS SUBJECTED TO WHOLE-BODY IRRADIATION. Morczek, Adolf; Schmidt, Wolfgang (Medizinische Akademie, Magdeburg, Ger.). Atomkernenergie, 14: 237-41(July-Aug. 1969). (In German).

For determining the course of radiation sickness and the influence of vitamin B 12, folic acid, vitamin B6, and pantothenic acid on the radiation syndrome 624 albino rats in groups of 24 animals each, to 480 of which the active substances were administered, were subjected to whole-body irradiations (10 R/min, 200 kV, 1.10 mm Cu half-value layer, 0.5 mm Cu filtration, 20 mA) with surface doses of 200, 400, 600, 800, 1000, and 1200 R. From the day of irradiation 0.25 μg/kg vitamin B 12 or 0.25 mg/kg folic acid or 250 mg/kg vitamin B 6 or 250 mg/kg panthenol or 0.25 μg/kg vitamin B 12 and 0.25 mg/kg folic acid in combination were daily administered intraperitoneally to the animals for a period of 7 days. The reparation-promoting effect of these active substances was determined from the blood picture, the survival rate, and the extent of intestinal reactions. The results obtained show that the substances tested are capable of producing in the range of sublethal doses, certain stimulating effects on the regeneration of both erythropoiesis and thrombopoiesis, that also results in an increase in the rate of survival following the administration of vitamin B 12 or folic acid, respectively. Stimulation of leukopoiesis was not observed. A reparation-promoting effect on the course of the radiation syndrome could not be observed after application of lethal radiation doses. Also, the intestinal reactions were not found to be reduced in the frequency and duration of diarrheas after administration of the active substances. From the results obtained it is justifiable to recommend the use of vitamin B 12 or folic acid or possibly vitamin B 6 in clinical practice in addition to other measures taken in the treatment of the radiation syndrome. The combined use of vitamin B 12 and folic acid does not appear to be necessary, as it was not possible to establish an intensification of the effect after simultaneous administration of these active substances. (auth)

48235 INVESTIGATIONS INTO UREA METABOLISM, DURING THE GASTROINTESTINAL SYNDROME AFTER WHOLE BODY IRRADIATION. Gerber, G. B.; Remy-Defraigne, J. (EURATOM, Mol, Belgium. Centre d'Etude de l'Energie Nucleaire, Mol, Belgium). Z. Gesam. Exp. Med., 150: 33-40(1969). (In German).

Urea metabolism was investigated in mice that were subjected to whole-body irradiation with doses causing gastrointestinal syndrome (3000 R). Urea ^{14}C was injected intraperitoneally and CO_2 collected. The distribution of the radioactivity in the tissues was also followed. The data indicate that urea degradation diminishes in starvation and even more after irradiation. The distribution of activity in tissue and its turnover suggest a more rapid excretion of urea from the first until the third day after exposure, presumably as a consequence of the polyuria. Excretion of urea diminishes, however, and tissue concentration rises shortly before the animals die. (auth)

48236 RADIATION TOLERANCE OF THE SKIN. von Essen, Carl F. (Yale Univ., New Haven). Acta Radiol., Ther., Phys., Biol., 8: 311-30(Aug. 1969).

Dynamic processes of cellular recovery, proliferation, and migration operate in response to radiation injury of the skin. The accelerated proliferation rates of survival epidermal and dermal cells in addition to migration of unirradiated cells into the radiated area may be of importance in differentiating restitution in tumors from normal skin. Small increments of dose and limited areas of exposure favor normal skin repair processes. The skin is moderately radiosensitized by high pressure oxygen and more markedly protected by anoxia. Supervoltage radiation may damage skin by subcutaneous overdosage. Isoeffect equations for time and area are probably over-simplified but useful at the level of present knowledge within the general time periods of radiation therapy. They can be restated thus: the dose required to produce a given skin reaction varies with the cube root of the overall time of exposure expressed in days and inversely with the cube root of the diameter of the irradiated field. (auth)

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Refer also to abstracts 47970, 47988, 47989, 48073, 48078, 48084, 48165, 48168–48175, and 48178–48181.

48237 (AD-690576) CARCINOGENESIS IN THE LUNG FROM INHALATION OF RADIOACTIVE PARTICLES. Final Report. Sanders, Charles L.; Thompson, Roy C.; Bair, W. J. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). May 1969. Contracts N00228-68-C-1421; AT(49-5)-2505. 80p. (USNRDL-TRC-69-8). CFSTI.

Consideration is given to the information available as to size and radioactivity of particles that might be produced in the testing or space application of uranium fueled reactors; the information available on the probability of deposition and retention in the lung of such particles, if inhaled; and information available from a variety of animal studies on the carcinogenic potential of radioactive materials deposited in the lung. This information is not sufficient to define the hazard with any degree of confidence, however, a model was derived that purports to estimate the carcinogenic risk associated with variously sized and activated particles from uranium fueled reactors. Based on this model it was concluded that where there were exposed people, the risks involved appear

to be acceptable risks. The model is of no predictive value where large numbers of people may be exposed and where low incidence effects become significant. Studies are described, and urgently recommended, that could lead to a better understanding of the mechanism of radiation-induced tumor formation in the lung. (TAB)

48238 (PB-184782) PERSPECTIVE ON POTENTIAL RADIATION HAZARDS. Cassady, James Robert (Bureau of Radiological Health, Rockville, Md.). June 1969. 14p. CFSTI.

The discussion attempts to show whether opinions on potential radiation hazards are based on fact, extrapolation, or pure speculation. It is obvious that the low dose effects of radiation postulated are almost entirely based on extrapolation and speculation. This discussion also attempts to show that, assuming the extrapolations performed are valid (which they most certainly are not), the magnitude of any potential hazard of medical x-ray to the general public under current radiological practice is almost unobservable. The author emphasizes that this does not mean that safety precautions need not be observed but rather that, if they are utilized and unnecessary x radiation is eliminated, the public should have no fear of potential consequences of medical x rays. (TAB)

48239 THE MANAGEMENT OF TEETH RELATED TO THE TREATMENT OF ORAL CANCER. Hayward, James R.; Kerr, Donald A.; Jesse, Richard H.; Castigliano, S. Gordon; Lampe, Isadore; Ingle, John I. CA - Cancer J. Clin., 19: 98-106(Mar.-Apr. 1969).

The occurrence and prevention of osteoradionecrosis and other oral side-effects of radiotherapy are reviewed. In seven series of patients who developed severe osteoradionecrosis, with eventual loss of the mandible following oral cancer irradiation from 1938 to 1964, there was a reduction in incidence of this complication from 13% to 3%. Severe osteoradionecrosis after oral cancer treatment is now estimated at 2% or less. The severity of bone changes has moderated since adoption of ^{60}Co and other supervoltage radiation techniques; the exposure of a necrotic area of bone no longer consistently leads to painful progressive bone exposure and loss of the entire mandible. Routine removal of all teeth before irradiation, which was advocated before 1950, now does not appear to be justified. Questionable teeth, with caries, pulpal or periodontal disease, or malposition, should be removed preirradiation. After radiotherapy, dental caries with involvement of the pulp, which would otherwise indicate extraction, should be treated endodontically when possible. Postirradiation caries depends upon many factors. Patients with high preirradiation caries activity are more vulnerable to caries activity due to irradiation changes. Mucositis induced by irradiation produces a tender mucosa, thus limiting the patient to a diet of soft foods. He also limits his oral hygiene procedures because of the mechanical irritation of brushing and the chemical irritation of a dentifrice. This results in a marked increase in caries activity. Histopathology of radioinduced salivary gland changes is described. (BBB)

48240 CELLULAR CHANGE ON BRONCHIAL EPITHELIAR CELLS IN LUNG CANCER BY PRE-OPERATIVE IRRADIATION. Otsuka, Toshimichi (Chiba Univ., Japan). Nippon Kyobu Geka Gakkai Zasshi, 17: 836-49(July 1969). (In Japanese).

Twenty-eight cases of lung cancer and six cases of non-malignant diseases of the lung treated with ^{60}Co γ irradiation were studied by serial brushing smears before, during, and after treatment. Malignant cells and benign epithelial cells have the following pattern of cellular changes induced by irradiation: enlargement of cytoplasm and nucleus; thickening of the nuclear rims; vacuolization of the cytoplasm and nucleus; and dissolution and destruction of the nucleus. Cellular changes of malignant cells differed in the histological types: in epidermoid carcinoma they appeared following 1000 to 2000 R tumor dose, and in adenocarcinoma following 1000 to 3000 R. Cellular changes of benign epithelial cells, especially basal and intermediate cells, induced by irradiation appeared following 2000 R and showed a difference in the degree of cellular changes and in individual radiosensitivity. Therefore the relation between radiation effects on benign epithelial cells and radiocurability of the carcinoma was studied in thirty-five cases of lung cancer and in six cases of non-malignant diseases of the lung in tissue resected after pre-operative irradiation, and in twenty-eight cases of lung cancer and six cases of non-malignant diseases of the lung in brushing smears. It showed a parallel between the impact of radiation on lung cancer and the reaction in benign epithelial cells in smears and tissue. From these results, it was concluded that the radiation effect on the cancer can be inferred from the cellular changes of benign epithelial cells caused by irradiation. (NSA of Japan)

48241 MORPHOLOGICAL CHANGES OF CARCINOMA OF CARDIO-ESOPHAGEAL LOCALIZATION FOLLOWING INTENSE IRRADIATION ON THE ROCUS UNIT. Lur'e-Pokrovskaya, T. A.; Chebotareva, T. I. (Inst. of Experimental and Clinical Oncology, Kiev). Arkh. Patol., 31: No. 7, 32-5(1969). (In Russian).

Morphological changes in tumors of the stomach following intensive preoperative irradiation on the Rocus unit (total dose 4000 to 4500 rad) are reported. Peculiar dystrophic changes terminated by cell death were revealed in cancer cells. The extent of these changes did not depend on the histological structure of the tumor. (auth)

48242 MORPHOLOGIC ASPECTS OF NONTUMOR LARYNGEAL TISSUE AFFECTED BY THE RADIATION BEAM IN THE COURSE OF TREATMENT OF CARCINOMA BY ELECTRONS ACCELERATED BY THE BETATRON. Buratti, Carlo (Univ., Milan). Ann. Laringol. Otol. Rinol. Faringol., 67: 809-27(Sept.-Oct. 1968). (In Italian).

Apparently normal tissue was biopsied 45 days after termination of high-energy electron therapy of five cases of laryngeal carcinoma. Radioinduced changes in this tissue were examined histologically in sections stained with hematoxylin-eosin and by Gomori's silver impregnation method. Laryngeal cartilage near the tumor site showed variable degrees of change. The chondrocytes were enlarged in diameter, weakly stained, and were in various stages of karyolysis. Electron irradiation appeared to affect more severely the chromatin in some cells than in others. Irregular deposition of calcified material occurred in the cartilage ground substance. Elastic fibers were frayed and fragmented, probably affecting the elasticity of the irradiated cartilage. It is suggested that the observed effects may be mediated by inactivation of enzymes by irradiation, especially phosphatases and phosphorylase. Muscle tissue showed hypotrophy and giant cell formation. (BBB)

48243 CHANGES IN THE RETICULOENDOTHELIAL ACTIVITY DURING PREOPERATIVE IRRADIATION OF GASTRIC CANCER, WITH SPECIAL REFERENCE TO THEIR RELATION TO THE HISTOPATHOLOGICAL CHANGES OF TUMOR. Hoshi, Hiroo; Ito, Keiemon (Tohoku Univ., Sendai). Gan No Rinsho, 15: 425-32(Apr. 1969). (In Japanese).

The purposes of preoperative irradiation of gastric cancer are to lower the activity of tumor cells and to reduce the danger of dispersion of tumor cells at the time of operation. However, the effects of irradiation on the systemic defense mechanism of the host cannot be ignored. The reticuloendothelial function, which is considered to be one of the most important of the systemic defense mechanisms, was investigated with regard to its postirradiation function as well as the behavior of the tumor interstice which is regarded to be one representation of reticuloendothelial activities. The congo red test was given to the surgical cases of gastric cancer: 30 cases of preoperative irradiation (long distance irradiation of ^{60}Co) and 55 cases without irradiation. The following results were obtained: Lowering of reticuloendothelial function was observed in 70% of the total patients. In the irradiated patients, general improvement of reticuloendothelial function was observed. The extent of improvement of the reticuloendothelial function due to preoperative irradiation was almost unrelated to the effect of irradiation on cancer parenchyma. Cellular exudative and the connective tissue reactions of the marginal interstice of cancer were higher in the irradiated cases than in the non-irradiated, especially marked in the cases with the satisfactory reticuloendothelial function in both irradiated and non-irradiated groups. The extent of improvement of the reticuloendothelial function paralleled the intensity of interstitial reaction. (NSA of Japan)

48244 USE OF RADIOIODIDE IN TREATMENT OF THYROID DISEASES. Dor, P.; Soumenkoff, J.; Henry, J. (Institut J. Bordet, Brussels). Acta Chir. Belg., Suppl. 1, 164-76(1969). (In French).

Risks of hypothyroidism, leukemia, and other late sequelae of therapeutic use of radioiodine, especially in hyperthyroidism, are reviewed. Clinical reports citing the incidence of thyroid cancer and leukemia in ^{131}I-treated patients are surveyed. Significant and persistent chromosomal damage has been observed in patients treated with radioiodine, suggesting that mutations may occur in descendants of treated persons. Problems in calculation of the ^{131}I dose in hyperthyroidism therapy are presented. Hypothyroidism is the most frequent complication of thyroid radiotherapy, and its incidence continues to increase years after treatment. The incidence varies from 1.4 to 16.8% as reported in different studies. Autoimmune disease of the thyroid may be responsible for part of this problem. Modifications of standard treatment methods that will help reduce hazards of radioiodine treatment are given. (BBB)

48245 CHONDROSARCOMA OF THE SCAPULA AFTER MAMMECTOMY AND X IRRADIATION. CASUISTIC CONTRIBUTION TO DIFFERENTIAL DIAGNOSIS OF THE STEWART-TREVES

SYNDROME. Zimmermann, G. (Landeskrankenanstalten, Salzburg, Austria). Muenchen. Med. Wochenschr., 110: 1647-51 (July 12, 1968). (In German).

A chondrosarcoma of the scapula was diagnosed 18 yr after an unknown total dose of fractionated x irradiation had been administered for treatment of mammary carcinoma. There were extensive radionecroses of the ribs and old, healed, spontaneous rib fractures. The thorax was somewhat narrowed in the cranial portion. The costal pleural membrane was thickened, and the marginal angle was adhesive. There were no pulmonary changes observed. In the shoulder blade area were saucer-sized calcifications, apparently due to calcification of necrotic, radiation-damaged soft tissues. Radionecroses were observed in the region of the acromion and the clavicle. There was lymphedema of the arm, but this was not considered to be etiologically related to irradiation. The location of the tumor indicated that it probably had been induced by previous x irradiations. The time interval between irradiation and tumor was in the range of 13 to 18 yr which was the usual latent period for x-ray-induced tumors of this type. It was believed that the total irradiation dose received was the most important causative factor, although neoplasms of this type have been observed even after diagnostic x-ray studies. Chondrosarcomas were induced in rabbits within 6 or 7 months of x irradiation doses of 8000 R, given in 40 doses of 200 R at 5-day intervals. (BBB)

48246 USE OF RADIOGOLD IN THE TREATMENT OF OVARIAN CANCER. Henry, J.; Mattheiem, W. (Institut J. Bordet, Brussels). Acta Chir. Belg., Suppl. 1, 177-83(1969). (In French).

Clinical results and complications after treatment of ovarian cancer with ^{198}Au are reported. Colloidal particles of 0.009 to 0.015 μ in size were injected intraperitoneally in doses of 100 to 150 mCi. Various reports indicate that radiogold produces better palliative and curative results than other methods of radiotherapy for this condition. No severe immediate complications occur, but late complications are relatively frequent. Radionecrosis has been reported, but results from faulty injection technique. Occlusive phenomena and multiple adhesions may develop. Fifteen such complications occurred among 102 patients given 2 doses of 120 mCi. With lower doses they can be prevented. A conservative approach in this radioisotope method is advised, and it may be combined with earlier surgery. (BBB)

48247 HIGH-VOLTAGE RADIOTHERAPY OF LYMPHOGRANULOMAS. Salis-Samaden, R. (Landeskrankenanstalten, Salzburg, Austria). Radiol. Austr., 18: 219-21(1968). (In German).

The advantages of ^{60}Co γ irradiation for treatment of lymphogranulomas were discussed. Because of the necessity to restrict treatment to no more than 2 fields of moderate size, and to use focal doses of 150 R/day, treatment required at least an entire month before the total dose of 4000 R was reached. When the lymphogranulomas to be treated were extensively distributed, more irradiation and longer treatment times were required. Extensive irradiations had to be terminated when the absolute number of lymphocytes dropped below 400/mm^3. Leukopenia was observed frequently after radiotherapy. By using ^{60}Co γ irradiation it was usually possible to reach a total dose of 4000 R without breaking off the treatment prematurely. The ^{60}Co γ irradiation also had an advantage because of its skin sparing effect, particularly for the neck, where lymphogranulomas frequently were localized. (BBB)

48248 CONSEQUENCES OF RADIOLOGIC EXPLORATION WITH THORIUM. Pizon, Pierre. Presse Med., 77: 241-4 (Feb. 8, 1969). (In French).

History of the use of ThO_2 (Thorotrast) as a radio-opaque agent in radiography is traced, as are reports of its detrimental effects in persons in whom it was injected. Thorium was first used in radiodiagnosis in 1927 for examination of the digestive tract and in 1929 as a means of opacifying the liver and spleen. At that time, the risk of radioactivity was considered negligible. Although it is relatively small, numerous reports, some of which date from 1912, have demonstrated that the danger of the radioactive substance is in its retention in the reticuloendothelial tissue which may cause fibrosis or a granuloma, or even cancer. Observations in man since 1947 have demonstrated the reality of this risk. Their number demonstrates the high frequency of these complications: 46.4% for the benign complications and 9% incidence of cancer. The average time for cancer to develop is 17.8 yr. Some other complications in which Th may be implicated are leukemia, aplastic anemia, liver failure, and congenital malformations. The large reticuloendothelial cell content of the liver makes it the most usual site of injury, and all stages of liver injury from Th have been described. Experimental studies of Th effects are also briefly described. The radioactivity of 1 ml of Thorotrast (0.25 g ThO_2) is 2.8×10^{-8} Ci, with 90% of the emission as α particles, which can be used to detect Th deposits in biopsy or autopsy material. The long half-life of the α emission provides for long-time irradiation of cells near Th deposits, with the result of fibrosis and/or carcinogenesis. (BBB)

48249 REMOTE SEQUELAE OF ACUTE RADIATION SICKNESS. Glazunov, I. S.; Blagoveshchenskaya, V. V. Zh. Nevropatol. Psikhiat., 68: 1129-34(1968). (In Russian).

Data on remote sequelae of acute radiation sickness is presented for a group of patients where acute radiation damage appeared as a result of a single exposure to γ rays, neutrons, and β particles in doses of 300 to 900 bre (biological radiation equivalent). Four types of neurological syndromes were seen, namely astheno-vegetative, diencephalic, syndromes of organic lesions of the nervous system (radiational encephalopathy) and astheno-dystrophical syndromes. The most characteristic pathological conditions in the late periods after radiation damage were changes of adaptive reaction. On the basis of clinicophysiological studies (thermoregulative reflexes, mobility of thermoreceptors and adaptation to different stimuli) an insufficiency of adaptative and compensatory possibilities was demonstrated—a syndrome of dysadaptation. This should be taken into consideration in the therapeutical measures, the assessment of working capacity and employment arrangements. (auth)

48250 HOWELL-JOLLY BODIES IN NORMOBLASTS OF SUBJECTS EXPOSED TO THE HAZARDS OF SMALL DOSES OF IONIZING RADIATION. Novakova, E.; Nosek, J. (Inst. of Public Health of the Uranium Industry, Pribram, Czech.). Cas. Lek. Cesk., 108: 318-20(Mar. 14, 1969). (In Czech).

The number of normoblasts containing Howell-Jolly bodies in the bone marrow of miners working in uranium mines was compared to that of the normal population. In the controls 5.3 ± 2.2 cells with Howell-Jolly bodies were found per 5,000 normoblasts; the corresponding figure for underground working miners was 9.3 ± 3.6 cells. (JPRS)

48251 CANCER OF THE LUNG, AND ITS RADIATION THERAPY. Kanno, Iwao. (Tohoku Univ., Sendai). Tohoku Igaku Zasshi, 78: No. 2, 51-61(Aug. 1968). (In Japanese).

Presupposing the erroneous diagnosis of pulmonary tuberculosis and cancer of the lung, the decreased morbidity of pulmonary tuberculosis and the gradual increase of pulmonary tumor, the advance of age among the pulmonary tuberculotics and the increase of pulmonary cancer in the advanced age group, difficulty in differential diagnosis of these two diseases and the problem of coexistence of the two, radiotherapy of cancer of the lung is discussed. The basic principles of radiotherapy are: to destroy cancer cells by x-ray as strongly as possible; to protect the adjacent normal tissues as much as possible; and to maintain the systemic condition as satisfactorily as possible. In the cases of pulmonary cancer, total radiation dosage for tumor and the period of irradiation in complete irradiation are basic questions. Usually, approximately 4000 to 6000 R are used for the period of 4 to 8 weeks. The common side reactions of ^{60}Co irradiation are pulmonary disorders and leukopenia. In view of the clinical symptoms, chest x-ray and the course of the patients, half of the irradiated cases experienced pulmonary disturbances in the form of the mixed existence of a series of pathological changes ranging from the pneumonic changes due to radiation pneumonia to fibrous pulmonary sclerosis which is called radiation fibrosis of the lung. Pulmonary disorders appeared in the cases irradiated more than 1000 R, increasing rapidly above 4000 R. However, the incidence of pulmonary disorders was not in parallel with the increase of dose. Defining leukopenia as the leukocyte count below approximately 3000/mm^3, it started with the tumor dose of above 1000 R with its incidence going up in parallel with the increase of the dose, reaching the maximum of 8000 R. Furthermore, the decrease of leucocyte count was also marked in those who had pulmonary disorders. (NSA of Japan)

48252 EEG EFFECTS OF POSTOPERATIVE IRRADIATION TREATMENT OF BRAIN TUMOURS. Hakansson, C. H.; Lindgren, M.; Sulg, I. A. (University Hospital, Lund, Sweden). Acta Radiol., Ther., Phys., Biol., 8: 301-10(Aug. 1969).

Six patients were investigated to determine whether ^{60}Co γ irradiation absorbed in the thalamic region could induce changes in the EEG record. The preliminary results indicate that half the maximal doses being given today in ordinary treatments produce changes in the cerebral activity. (auth)

48253 CONGENITAL MINOR ANOMALIES IN MENTALLY RETARDED CHILDREN. Arima, Masataka; Koyima, Kazuhiko; Ono, Kazuo; Hisada, Kazuko (Toho Univ., Tokyo). Proc. Aust. Ass. Neurol., 5: 177-82(1968).

The frequency of associated minor anomalies was determined for patients with brain defect of congenital origin, and compared to the frequency in normal controls. Among groups of mental deficiency, cerebral palsy, and epilepsy, the highest incidence of anomalies was found in the group of mental deficiency. Mentally retarded patients associated with fetal irradiation showed a high frequency of anomalies of the skin. Patients with epilepsy of normal intelligence or hereditary metabolic diseases of the central nervous system did not show a difference in the frequency of anomalies compared with normal controls. (auth)

Radiation Effects on Plants

Refer also to abstracts 48008–48011, 48013, 48017–48019, 48021, 48023, 48024, and 48047.

48254 (NYO-2043-194, pp 1-5) RADIOSENSITIVITY OF TROPICAL PLANT SPECIES. Moh, C. C. (Inter-American Inst. of Agricultural Sciences, Turrialba (Costa Rica)).

The ^{137}Cs γ-radiosensitivity of tropical plants was determined in the field under conditions of chronic irradiation. The tropical gymnosperms; Sequoias, Cypress, Cycads, and Zamia were more sensitive to irradiation than were the legume species tested including; Canavalia gladiata, Dolichos lablab, Leucaena glauca, and Tephrosia vogelli. None of the gymnosperms survived a daily dose of 60 R over a period of 1 yr, while doses of more than 60 R/day did not prevent the legumes from completing their life cycle. (E.R.B.)

48255 SACCHAROMYCES CEREVISIAE MUTANT WHICH MAY SHOW CYTOPLASMIC SENSITIVITY TO ULTRAVIOLET LIGHT. Game, J. C.; Cox, B. S. (Univ. of Oxford, Eng.). Nature (London), 223: 1067-8(Sept. 6, 1969).

It is stated that in yeast, as well as other microorganisms, mutants have been isolated which are more sensitive than normal wild type strains to UV light, and that it is thought that such mutants are defective in some component of the DNA dark repair system, and that their study might throw more light on the processes of dark repair of damaged DNA. It is to be expected that such mutants will show greater UV resistance in the homozygous diploid state than in the haploid state, and certain types of highly sensitive mutants have been shown to exhibit this expected increased resistance in the diploid state. Not all UV sensitive mutants, however, are necessarily defective in a DNA repair system. In some cases damage leading to death of the cell is cytoplasmic rather than nuclear, involving for example some lipoprotein membrane system which, by a gene determined change, has become unusually sensitive to UV. Some comparative studies are reported on the survival of UVS-7 and wild type yeast strains to 2537 Å light. With UVS-7 the homozygous diploid did not show better survival than the haploid parents. Photoreactivation studies were also made, with no effect at lower doses. It is concluded that in the case of UVS-7 prima facie evidence was obtained for UV sensitivity through a mechanism other than faulty DNA repair. (UK)

48256 REDUCED GENE TRANSMISSION AND GENOTYPIC RATIO. Moh, C. C. (Interamerican Inst. of Agricultural Sciences, Turrialba, Costa Rica). Contract AT(30-1)-2043. Caryologia, 21: No. 1, 33-6(1968).

It is a common phenomenon that many of the radioinduced mutations in higher plants show a deficiency of mutants in a segregating population, although the mutant genes are of a simple recessive nature. The number of heterozygotes is also less than the expected ratio of one normal: two heterozygotes. Moreover, mutant lines segregating a similarly low frequency of mutants do not necessarily produce the same percentage of heterozygotes. Calculations of some theoretical examples based on reduced transmission of the mutant gene through male and/or female gametes are presented to illustrate such phenomena. (auth)

48257 DIRECT EVIDENCE FOR MODELS OF HETEROSIS PROVIDED BY MUTANTS OF ARABIDOPSIS BLOCKED IN THE THIAMIN PATHWAY. Li, S. L.; Redei, G. P. (Univ. of Missouri, Columbia). Theor. Appl. Genet., 39: 68-72(Apr. 28, 1969).

In the short life cycle of the autogamous crucifer, Arabidopsis thaliana, thiamin (vitamin B_1) auxotrophs were readily induced by ionizing radiation or by chemical mutagens. These mutants were used to obtain evidence for the dominance and superdominance models of hybrid vigor and the operation of physiological homeostasis at the allelic level. The auxotrophic mutants genetically blocked at different steps of the thiamin pathway demonstrated the biochemical mechanism of hybrid vigor due to simple and perfect dominance at two unlinked loci. Heteroallelic hybrids of mutants requiring the pyrimidine moiety of thiamin display allelic complementation and thus furnish clear biochemical and genetic evidence for the superdominance hypothesis. Hybrids of low- and high-temperature-requiring leaky mutants demonstrated that heterozygosity at a single gene locus may confer developmental homeostasis on the heteroallelic combinations superior to that of the homoallelic parents. The results on the autogamous plant Arabidopsis and on the outbreeding species Drosophila contradict the generalization that high vs. low temperature dependent heterosis is determined by the breeding system. (BBB)

48258 EFFECT OF IONIZING RADIATION ON THE VIABILITY AND FREQUENCY OF OCCURRENCE OF MORPHOLOGICAL VARIATIONS OF THE FUNGUS BEAUVERIA BASSIANA (BALS.) VUILL. Evlakhova, A. A.; Martens, B. K. Mikol. Fitopatol., 2: 274-8(1968). (In Russian).

The survival rate of the entopathogenic fungus Beauveria exposed to γ and x rays was found to depend on the dose and intensity of the radiation. A decrease in the intensity with the same dose lowered the survival rate. It also gave rise to more morphological variations, that occurred when doses and intensities decreased the survival rate to 14 to 35 percent. The doses and intensities at which the survival rate was 100% higher than in the control, i.e., stimulating doses, did not induce any variations. The findings can be used in work on radiation mutagenesis and breeding of new forms of entomopathogenic fungi possessing a high degree of virulence. (JPRS)

48259 EFFECTS OF γ-RAY IRRADIATION ON THE AUTOTETRAPLOID OF THE MULBERRY TREE. Tojyo, Isao (Sericultural Experiment Station, Fukushima, Japan). Nippon Sanshigaku Zasshi, 38: No. 1, 55-63(Feb. 1969). (In Japanese).

Effects of irradiation on budding in the autotetraploid, diploid, and the resultant triploid were examined by exposing the dormant bud of mulberry cuttings to γ rays (2.5 to 10.0 KR) from a Co source. The sprouting of buds was delayed or inhibited with increasing dose in all cases. However, the autotetraploid and triploid seemed to be less sensitive to irradiation than the diploid, even in the succeeding stages of plant growth and development. A slight difference in budding between diploid and autotetraploid was observed, although the latter used to sprout later under ordinary cultivated conditions. Due to the secondary effects of irradiation, the leaves were reduced in size and new shoots showed slower growth at doses greater than 5.0 KR in the diploid, and 7.5 KR in the autotetraploid. A few cuttings survived at doses of 7.5 to 10.0 KR in the diploid while many cuttings survived at the same dose in the autotetraploid. Abnormalities in plant growth and morphological characters were observed at 5.0 to 7.5 KR in the diploid and 7.5 to 10.0 KR in the autotetraploid. (auth) (TSS)

48260 ON THE IMPROVEMENT OF VEGETABLE PROTEIN BY RADIATION BREEDING. Tamura, Shinpachiro (Food Research Inst., Tokyo). Aminosan Kyokai Gijutsu Bukai-ho (Tokyo), No. 107, 1-28(Dec. 1968). (In Japanese).

Animal protein contains enough of the essential amino acids, but vegetable protein is deficient. Rice protein is relatively superior in quality, but contains insufficient lysin and threonine. By adding these two amino acids to rice, the constitution of rice protein becomes near to animal protein. The improvement of rice protein was attempted by the method of radioinduced mutations. The experiment was performed in a radiation nursery of the Ministry of Agriculture and Forestry with a γ-ray-field, where ^{60}Co was placed in the center of the farm. It aimed to obtain rice with a different composition and protein content from normal rice. So far rice with a different pattern of amino acids has not appeared, but rice with a high protein content was obtained. It is believed that arginine, one of the amino acids of rice, is converted into threonine by mutation. (auth)

Radiation Effects on Microorganisms

Refer also to abstracts 47971, 47986, 48014, 48016, 48187, and 48191.

48261 (NYO-2740-6, pp 303-18) INTERACTIONS OF λ VIR AND OF U.V.-IRRADIATED T_1 BACTERIOPHAGE DURING MIXED INFECTION. Drakulic, Maria (Columbia Univ., New York. Radiological Research Lab.).

The repair of uv-radioinduced damage to the DNA's of λ_{vir} and T_1 bacteriophages infecting the same host bacterium was studied to determine the possibility that there is a preference of the host-repair enzyme system for different DNA's and/or for different types of damage (uv, x, chemicals). Five strains of Escherichia coli were used as host bacteria, resistant host for T_1, λ-sensitive, λ and T_1 sensitive, λ-resistant, and T_1-resistant. Two of the results obtained in the investigation are discussed. One was

the existence of peculiar features of the survival curves of uv-irradiated T_1 phage, the other was the suggestion of a cooperative interaction between two unrelated bacterial viruses upon mixed infection, under conditions that were limiting for both phages. Several assumptions are made regarding these two findings that further experimental work will seek to verify. (E.R.B.)

48262 (NYO-2740-6, pp 327-44) EFFECTS OF VERY SOFT X-RAYS ON BACTERIAL SPORES. Clark, B. C.; Hill, R. F. (Columbia Univ., New York. Radiological Research Lab.).

The results of irradiation of spores of three strains of Bacillus subtilis with x rays from either aluminum, yttrium, molybdenum, or silver are presented. A lack of significant dependence of the values of n (extrapolation number) and D_0 (radioresistance of organism) upon the target material used to produce the x rays was observed. The RBE of very soft x rays and higher energy x rays was determined using a 180 kvp x-ray machine and very soft x rays (molybdenum target). Using spore survival as the criterion, it was found that soft x rays were more effective than hard x rays, (RBE-1.99). The interactions of soft x rays and uv light were determined using spore survival as the criterion. Spores were x-irradiated (yttrium or molybdenum target), exposed for 2 hrs to photoreactivating wave lengths, then uv-irradiated and incubated without photoreactivating wave lengths. The results were that no differences were observed between the x rays from either yttrium or molybdenum targets, and the slopes of the survival curves for uv-irradiated and not uv-irradiated spores were very close. The normal survival curve (no uv irradiation) had the typical shoulder at low doses, while the data for uv treatment could be fully described by an exponential curve. (E.R.B.)

48263 ABSORPTION OF MICROWAVES BY MICROORGANISMS. Webb, S. J.; Booth, A. D. (Univ. of Saskatachewan, Saskatoon, Can.). Nature (London), 222: 1199-1200(June 21, 1969).

Investigations are reported on the absorption of 65 to 75 GHz microwaves by cells of Escherichia coli B_R and by isolated protein, RNA and DNA, and also the effect on some metabolic processes. Absorption spectra are shown for the E. coli cells, and for H_2O, protein, RNA and DNA. It was found that bacterial cells absorb microwaves of definite frequencies and that the absorbed energy alters metabolic processes and cell growth. Temperature changes do not appear to play a part. None of the frequencies employed killed the cells. It is considered that the use of mm microwaves may be very useful in detailed cell studies; whereas the ir spectra of DNA and RNA show only minor differences, the microwave spectra between 64 and 75 GHz are very different, and both differ extensively from that of protein. (UK)

48264 ON THE REGULATION OF THE INITIATION OF DNA REPLICATION IN BACTERIA. Yoshikawa, Hiroshi; Haas, Martin (Univ. of California, Berkeley). Cold Spring Harbor Symp. Quant. Biol., 33: 843-55(1968).

From 33rd Cold Spring Harbor Symposium, Cold Spring Harbor, N. Y. See CONF-680631.

Regulation of initiation of DNA replication was studied in a strain of Bacillus subtilis, 168, that was more sensitive to uv irradiation than the parental strain. Abnormal initiations in B. subtilis were studied under conditions of rich media, 5-bromodeoxyuridine treatment, and thymine starvation. The initiations were investigated in synchronously replicating germinated spores. Comparison of these three treatments showed that the treatments were not directly responsible for abnormal initiations, but rather that they acted indirectly through a cellular regulatory mechanism. Induction of two temperate phages (SPO2 and PBSH) was also studied and the relation explored between this and initiation of host chromosome replication. Induction of the temperate phages and initiation of replication occurred simultaneously after either uv or Mitomycin C treatment. The results suggested that initiation of replication is regulated by a mechanism similar to that which causes prophage induction. (BBB)

48265 METABOLISM AND GROWTH OF GENE SUBSTANCE: 1968. Hotchkiss, Rollin D. (Rockefeller Univ., New York). Cold Spring Harbor Symp. Quant. Biol., 33: 857-70(1968).

From 33rd Cold Spring Harbor Symposium, Cold Spring Harbor, N. Y. See CONF-680631.

Replication and repair of DNA, particularly after damage by ionizing or nonionizing radiation, are reviewed. Dark repair of uv or other damage in DNA is pictured as involving four steps: endonucleolytic opening of one chain, exonucleolytic removal of a defective section of that chain, polymerase-induced restoration of the missing section, and ligase-induced rejoining of the gap. An enzyme from Micrococcus specifically incises one strand of uv-irradiated double-stranded DNA efficiently near the site of pyrimidine dimer formation. The incision enzyme, besides responding specifically to uv damage, differs from usual endonuclease in not requiring Mg ions. The second step is exonucleolytic and Mg dependent. For Hemophilus mutants, two cistrons govern excision, one of which is required for making the first cut in uv-DNA and has been tested in vitro (the other governing, perhaps, the exonuclease). Another mutant, which has lost the ability to repair both uv- and x-ray-induced breaks, shows inefficient incorporation of markers from transforming DNA. Relations between recombination ability and ability to carry out dark repair of uv damage in wild and mutant E. coli strains are discussed, as well as a model providing for three effects of ^{32}P decay: breaks in single strands, simultaneous breaks in double strands across the wide groove, and very damaging ones across the narrow groove. In uv-treated normal cells, repair labels all parts of the chromosome, not uniquely the previously replicating portion. Study of the retention of uv damage in replicating bacteria shows that replica daughter DNA strands have chain interruptions, probably at sites complementary to pyrimidine dimers. These findings are in line with general mechanisms of DNA transformation, and suggest that exposed ends of DNA, strand breaks, or discontinuities offer stimulus or challenge leading to recombination events. (BBB)

48266 PHAGE DNA SYNTHESIS IN BACTERIA INFECTED WITH T4 LIGHT PARTICLES. Amati, Paolo; Favre, Renee (International Lab. of Genetics and Biophysics, Naples). Cold Spring Harbor Symp. Quant. Biol., 33: 371-4(1968).

From 33rd Cold Spring Harbor Symposium, Cold Spring Harbor, N. Y. See CONF-680631.

Phage T4 light particles (T4 lp), though unable to synthesize DNA extensively in single infection, are able to synthesize early enzymes at the normal rate, carrying such synthesis beyond the normal time of shut-off of early enzyme synthesis like normal phages that fail to replicate if uv-irradiated or if blocked in some early function. A study was made of whether the failure of T4 lp to synthesize DNA in single infection results from the failure of incomplete genomes to carry genetic information for all enzymatic activities needed, or from the structural inability of the incomplete genomes to constitute a replicon, perhaps because they lack a terminal redundancy. The method used uv-killed cells (to markedly reduce the level of host DNA synthesis) and T4 lp, purified from lysates of T4 mutants in gene 66, that produces predominantly light particles. The measurement of DNA synthesis was performed by 1-min pulses of ^{14}C-thymidine. The results obtained with T4 lp infection were compared and calibrated with those of T4 wt (wild type). Exponentially growing cultures of Escherichia coli B phr^- were uv irradiated at a dose giving 5×10^{-1} survivors. The results showed that cells infected with T4 lp at high minutes-after-infection valves are able to synthesize phage DNA. Furthermore, a cell which could synthesize DNA after T4 lp infection did so at the same rate as after T4 wt infection. On the basis of such a concept, about 7 to 8 T4 lp are needed to achieve a productive infection. Chloramphenicol (CAP) inhibited initiation of a new cycle of DNA synthesis while permitting the completion of the cycle in progress when the antibiotic was added. Moreover, synthesis of phage DNA, and in particular that of T4 was about 10 times less than bacterial DNA to CAP inhibition. T4 lp which lack a terminal redundancy will be unable to circularize and, consequently, to synthesize DNA. If, however, a complete circular T4 molecule (replicon) were formed by recombination between complementary T4 lp, replication could then occur. (BBB)

48267 COLD SPRING HARBOR SYMPOSIA ON QUANTITATIVE BIOLOGY. VOLUME 33. REPLICATION OF DNA IN MICROORGANISMS, JUNE 5-12, 1968. Cold Spring Harbor Symp. Quant. Biol., 33: 1-884(1968). (CONF-680631).

The main topics considered at this symposium included replication of nucleic acids, intermediates in DNA synthesis, repair of DNA, genetics of replication, structure of replication DNA, origins of replication, bacterial mating, replication and the cell membrane, replication of temperate viruses, and regulation of replication. Several reports referred to the use of ionizing and nonionizing (uv) radiation to damage to DNA-replicating mechanism in microorganisms or to cause the formation of abnormal DNA molecules. Repair of radiation injury and factors responsible to differential radiosensitivity of microorganisms were examined in particular. Separate abstracts were prepared on 25 of the 92 reports in this symposium. The symposium is summarized in a discussion entitled "Metabolism and Growth of Gene Substance: 1968." (BBB)

For abstracts of individual papers see: 47917, 47971, 47972, 48187, 48257, 48264–48266, and 48268–48284.

48268 RESCUE OF DNA FROM UV-IRRADIATED T4 PHAGE. Shahn, E. (Hunter Coll., New York). Cold Spring Harbor Symp. Quant. Biol., 33: 205-7(1968).

From 33rd Cold Spring Harbor Symposium, Cold Spring Harbor, N. Y. See CONF-680631.

Experiments performed on the rescue of DNA from uv-irradiated T4 phage showed that with increasing doses of uv, the size of the parental contributions decreased, the number of such contributions per phage increased, and the enzymes necessary for rescue are other than those required merely for replication of DNA. Heavy (5-bromouracil, BU-labeled) bacteria in heavy medium were simultaneously infected with light, ^{32}P-labeled, irradiated phage, and light, nonlabeled, nonirradiated rescuing phage. Replication and the extent of material recombination (i.e., dispersion) of the irradiated phage DNA were detected by the observed increase in density of the ^{32}P label in CsCl density gradients. The effect of different shearing conditions on the DNA extracted from the resulting progeny phage demonstrated that the size of the parental contribution to progeny phages decreases with increasing doses of uv irradiation given the parental phages. Experiments with chloramphenicol-treated bacteria indicated that rescue of irradiated phage DNA requires an enzyme or enzymes which, in the nonirradiated system are responsible for recombination and repair, or are synthesized concurrently. (BBB)

48269 DNA REPLICATION AND RECOMBINATION AFTER UV IRRADIATION. Howard-Flanders, Paul; Rupp, W. Dean; Wilkins, Brian M.; Cole, Ronald S. (Yale Univ., New Haven). Cold Spring Harbor Symp. Quant. Biol., 33: 195-205 (1968).

From 33rd Cold Spring Harbor Symposium, Cold Spring Harbor, N. Y. See CONF-680631.

Pyrimidine dimers formed in the DNA of uv-irradiated Escherichia coli remain in situ in excision-defective mutants. When DNA containing uv-induced pyrimidine dimers is replicated, the newly synthesized strands are of low molecular weight, as if formed with gaps at a spacing approximately equal to that between the pyrimidine dimers. Since DNA is also replicated during transfer between mating bacteria, it is possible to use mating systems involving uv-irradiated donor cells to test whether the newly synthesized strand also contains gaps or discontinuities and, if so, whether these are directly opposite the pyrimidine dimers. When excision-defective male bacteria are exposed to uv light and mated with suitable females, DNA is transferred at almost the normal rate, even after uv doses of several hundred erg/mm^2. When uv-irradiated F lac$^+$ donors are mated with suitable recipients, damaged episomes are transferred, but fail to form secondary F lac$^+$ donors. These damaged episomes can be photoreactivated in the recipient by exposure to visible light and restored to a fully active form. They are not, however, subject to repair by excision after transfer. Since an intact complementary strand is required for repair by excision, the lack of detectable repair of the transferred episome by this process suggests that there may be gaps or defects of some kind in the strand synthesized during transfer, and that these are directly opposite the dimers. An increased frequency of genetic exchanges occurs in crosses with uv-irradiated donors. The uv-induced recombination is initiated with high efficiency after replication, when the DNA contains dimers and opposing gaps. The efficiency of these dimers and gaps may be due to their relative longevity in comparison with other types of defects which are subject to removal by repair enzymes. (BBB)

48270 REPAIR REPLICATION OF DNA IN VIVO. Hanawalt, Philip C.; Pettijohn, David E.; Pauling, E. Crellin; Brunk, Clifford F.; Smith, Douglas W.; Kanner, Lee C.; Couch, John L. (Stanford Univ., Calif.). Cold Spring Harbor Symp. Quant. Biol., 33: 187-94 (1968).

From 33rd Cold Spring Harbor Symposium, Cold Spring Harbor, N. Y. See CONF-680631.

Ultraviolet-damaged DNA in bacteria and in some other cellular systems may be repaired by a mechanism that involves the replacement of the defective single-strand regions with a short stretch of oligonucleotide utilizing the complementary base pairing information in the intact strand. Direct physical evidence for such reconstruction of the excised region was obtained in a study of the qualitative nature of DNA replication in uv-irradiated bacteria. The generality of such repair replication is suggested both in terms of the types of damage that can be recognized and repaired by this mode in vivo and the range of organisms in which this mode can be demonstrated. The possible relation of repair replication to normal nucleic acid metabolism in vivo is also considered. The early incorporation of radioactively labeled 5-bromouracil (BU) into the DNA of Escherichia coli TAU-bar following uv irradiation resulted in little density shift of those DNA fragments that contained the BU. The radioactive label was shown to be still in BU by acid hydrolysis of the DNA and by paper chromatography. Illumination of the bacteria with visible light after uv but prior to the addition of BU reduced the extent of this unusual mode of incorporation, as expected if photoreactivation had split the pyrimidine dimers in situ. It was also possible to demonstrate repair replication in bacteria using combined D_2O, ^{15}N, and ^{32}P for density labeling the parental DNA. The normal mode of replication can also be suppressed through the use of a temperature-sensitive DNA replication-deficient mutant. The efficiency of utilization of thymine and BU for normal and repair synthesis in bacteria was studied. A distinctly greater selectivity for thymine over BU was expressed in the nonconservative repair mode of DNA replication than in the semiconservative mode. The nonconservative repair mode of DNA replication was also observed following treatment of bacteria with the bifunctional alkylating agent, nitrogen mustard. Since this agent primarily attacks the 7-nitrogen position of guanine, the defect produced bears little resemblance to the pyrimidine dimers induced by uv. It is likely that the repair system recognizes gross distortions in the phosphodiester backbone of the DNA rather than specific base defects. (BBB)

48271 THE ROLE OF POLYNUCLEOTIDE LIGASE IN NORMAL DNA REPLICATION. Pauling, E. C. (Univ. of California, Riverside). Cold Spring Harbor Symp. Quant. Biol., 33: 148-50 (1968).

From 33rd Cold Spring Harbor Symposium, Cold Spring Harbor, N. Y. See CONF-680631.

A mutant strain of Escherichia coli TAU-bar was isolated that is defective in a late step in the sequence of reactions involved in the dark repair of uv-induced lesions. Such a mutation should be lethal, so a search was made for a temperature-sensitive, radiation-sensitive mutant. The properties of one mutant, ts-7, that was isolated are described. Survival curves are shown for TAU-bar, the parent strain, and for ts-7 following uv irradiation. TAU-bar itself is temperature-sensitive with respect to radiation resistance, as the temperature of postirradiation incubation has a clear effect on survival. After 60-sec uv irradiation, survival is 0.15% if it is incubated at 40°C for 2 hr after plating and then transferred to 25°C, whereas survival is 0.01% if incubated at 25°C throughout. The mutant strain ts-7 is slightly more sensitive to uv irradiation than TAU-bar when incubated at 25°C, although the slope of the survival curve is not significantly affected. However, when it is held at 40°C for 2 hr prior to incubation at 25°C, survival is drastically reduced: for 40-sec irradiation survival is 0.0018%, compared to 3% for TAU-bar incubated under similar conditions. The ability of ts-7 to excise uv-induced lesions from the DNA was evident both at 25°C and 40°C, and ts-7 could perform nonconservative repair replication both at 25°C and 40°C. Therefore, this strain is able to perform the sequence of reactions in the dark-repair process through the polymerization step, and thus the rejoining step, probably catalyzed by DNA ligase, becomes implicated. Fragments of DNA synthesized as a result of discontinuous replication accumulated in this strain. Thus ts-7 is classed as a mutant defective in the enzyme DNA ligase. The response to uv irradiation, accumulation of newly replicated fragments of DNA at 40°C, and reduced in vitro DNA ligase activity are consistent with this interpretation. Both DNA strands are replicated in a discontinuous manner, but the integrity of the parental strands is maintained during replication. (BBB)

48272 BREAKAGE OF DNA IN REC$^+$ AND REC$^-$ BACTERIA BY DISINTEGRATION OF RADIOPHOSPHOROUS ATOMS IN DNA AND POSSIBLE CAUSE OF PLEIOTROPIC EFFECTS OF RecA MUTATION. Tomizawa, Jun-ichi; Ogawa, Hideyuki (National Inst. of Health of Japan, Tokyo). Cold Spring Harbor Symp. Quant. Biol., 33: 243-52 (1968).

From 33rd Cold Spring Harbor Symposium, Cold Spring Harbor, N. Y. See CONF-680631.

A comparison of the efficiencies of ^{32}P killing in phages and bacteria stored under similar conditions showed that the efficiency of ^{32}P killing in phages and in rec$^-$ bacteria is the same while that in the rec$^+$ bacteria is about ½ as great. Quantitative studies were done on breakage of strands of DNA and on the lethal effect of ^{32}P disintegration by an accurate and sensitive method in which the change in molecular structure of phage λ DNA was measured by sucrose density gradient centrifugation. Every disintegration of ^{32}P breaks 1 polynucleotide strand (single-strand breakage) and some disintegrations cause breakage of both complementary strands (simultaneous breakage). Simultaneous breakage of both strands can break the double-stranded DNA molecule (double-strand breakage). However, the breakage of both complementary strands by a single disintegration does not necessarily result in breakage of a double-stranded DNA molecule as a whole. With λ DNA at 15°C about 30% of simultaneous breaks are not double-strand breaks, while at 65°C practically all the simultaneous breaks are double-strand breaks. The single-strand breaks are efficiently repaired in bacteria, that is, connected by polynucleotide bonds. The recovery process occurs in both rec$^+$ and rec$^-$ bacteria and is presumably mediated by the participation of polynucleotide kinase and a polynucleotide joining enzyme. Studies on

the sensitivity of abortive transducing fragments of phage P1 showed that the abortive transductants of both rec$^+$ and rec$^-$ bacteria were lost at a similar efficiency and that the efficiency is similar to that of the loss of intracellular infective phage. These efficiencies were about one in 23 ^{32}P disintegrations, similar to the efficiency of killing of rec$^-$ bacteria. As additional effects of a recA mutation, absence of uv-reactivation capacity for uv-irradiated phage λ and an inability to induce various types of uv-induced mutations of phage λ and bacteria are described. (BBB)

48273 RECOVERY OF RECOMBINATION DEFICIENT MUTANTS OF ESCHERICHIA COLI K-12 FROM ULTRAVIOLET IRRADIATION. Ganesan, Ann K.; Smith, Kendric C. (Stanford Medical School, Palo Alto, Calif.). Cold Spring Harbor Symp. Quant. Biol., 33: 235-42(1968).

From 33rd Cold Spring Harbor Symposium, Cold Spring Harbor, N. Y. See CONF-680631.

Although the recombination deficient, or rec mutants of Escherichia coli K-12 are more uv sensitive than their rec$^+$ counterparts, some of them have acquired two recovery processes not observed in wild-type K-12. Experiments showed that the rec and uvr genes of E. coli K-12 mediate two dark repair processes which differ with respect to the type of lesion they repair. The uvr genes mediate the excision-repair of damaged bases in DNA, while the rec genes mediate the repair of gaps left in the daughter strand when DNA synthesis proceeds past damaged bases. The uvr mutations prevent the efficient removal of pyrimidine dimers from the DNA of irradiated cells, resulting in increased sensitivity to uv, but not to x irradiation which does not produce dimers. The rec mutations reduce the efficiency with which gaps in cellular DNA are healed. This results in greater sensitivity to x irradiation, which produces both single and double strand breaks in DNA. The system controlled by uvr genes that acts directly upon damaged bases and removes them from the irradiated DNA, can occur in the absence of amino acids. The system controlled by rec genes does not act directly upon damaged bases, but facilitates repair of gaps formed when lesion-containing DNA is replicated. It is postulated that this latter mode of repair cannot occur until replication has resulted in the production of gaps (opposite the damaged bases), and therefore cannot take place while the irradiated cells are held in buffer or minimal medium lacking required amino acids. (BBB)

48274 EFFECT OF ^{32}P DECAY ON CHROMOSOME TRANSFER BY A RADIATION-SENSITIVE HFR STRAIN OF ESCHERICHIA COLI. Steinberg, Robert A. (Harvard Univ., Cambridge, Mass.). Cold Spring Harbor Symp. Quant. Biol., 33: 253-7(1968).

From 33rd Cold Spring Harbor Symposium, Cold Spring Harbor, N. Y. See CONF-680631.

Whether cells in which DNA synthesis had been stopped by ^{32}P decay can still transfer chromosomal markers was tested in two Hfr strains of Escherichia coli: AB3060, a T6^s Hfr J2 carrying the recombination deficient marker rec$^-$13, that makes it more sensitive to radiation damages than wild-type strains; and a radiation-resistant derivation of AB3060 obtained by transduction using phage P1 and selected for its insensitivity to low doses of uv light. These two strains are referred to as Hfr rec$^-$ and Hfr rec$^+$. The effects of decay of incorporated ^{32}P on conjugational chromosome transfer indicated that the sensitive target for transfer inactivation is the entire Hfr chromosome and that differential marker transfer inactivation is dependent upon the amount of time it takes for a genetic marker to be transferred out of the donor cell. Hfr rec$^+$ showed the same relative marker transfer inactivations as did Hfr rec$^-$, suggesting that a time-dependent factor might be involved in rec$^+$ as well as in rec$^-$. (BBB)

48275 STUDIES WITH DNA-CELLULOSE CHROMATOGRAPHY. I. DNA-BINDING PROTEINS FROM ESCHERICHIA COLI. Alberts, Bruce M.; Amodio, Frank J.; Jenkins, Myrna; Gutmann, Ernest D.; Ferris, Frederick L. (Princeton Univ., N. J.). Cold Spring Harbor Symp. Quant. Biol., 33: 289-305(1968).

From 33rd Cold Spring Harbor Symposium, Cold Spring Harbor, N. Y. See CONF-680631.

A method for separating DNA-binding proteins was developed in which DNA adsorbed to cellulose columns was used as a matrix. Such DNA-cellulose chromatography enabled isolation of T4 bacteriophage proteins with a specific affinity for uv-irradiated DNA. To prevent possible slowly exchanging, nonspecific proteins from complexing with the DNA-cellulose, an excess of unirradiated T4 DNA was added and incubated with an extract, which was then pumped slowly over a uv-irradiated T4 DNA-cellulose column, followed by an extensive unirradiated T4 DNA wash. About 0.5% of the T4-induced soluble protein bound preferentially to the uv-irradiated T4 DNA. However, 0.2% binding was observed to an unirradiated T4 DNA-cellulose column in an otherwise identical control experiment run simultaneously. The difference, 0.3% of the total soluble phage-induced protein, was reproducible and represented preferential binding to uv-irradiated DNA. In extracts made from cells infected with T4v$_1$, a uv-sensitive bacteriophage mutant, this preferential binding was eliminated. Therefore, proteins exhibiting preferential binding to the irradiated DNA may be part of the bacteriophage repair system. (BBB)

48276 REPAIR AND RECOMBINATION IN PHAGE T4. II. GENES AFFECTING UV SENSITIVITY. Baldy, Marian W. (Univ. of California, Davis). Cold Spring Harbor Symp. Quant. Biol., 33: 333-8(1968).

From 33rd Cold Spring Harbor Symposium, Cold Spring Harbor, N. Y. See CONF-680631.

The effect of temperature-sensitive (ts) mutations in five early function genes on the sensitivity of phage T4D to uv light was determined. Temperature-sensitive mutations in genes 30, 43, and 47 were found to increase the sensitivity of T4D to uv light. Mutations in genes 45 and 56 did not alter uv sensitivity. The results indicated that three enzymes expected to catalyze steps in the process of uv repair, on the basis of a model which has been proposed, do serve this function in phage T4. With regard to the question of whether gene 43, specified DNA polymerase, is a repair enzyme or the catalyst of normal DNA replication, the experiments showed that the polymerase plays a role in DNA repair; however, they did not deal with the question of its participation in normal replication. (BBB)

48277 REPAIR AND RECOMBINATION IN PHAGE T4. I. GENES AFFECTING RECOMBINATION. Bernstein, Harris (Univ. of California, Davis). Cold Spring Harbor Symp. Quant. Biol., 33: 325-31(1968).

From 33rd Cold Spring Harbor Symposium, Cold Spring Harbor, N. Y. See CONF-680631.

Temperature-sensitive (ts) mutations in early function genes of phage T4, some of which are implicated in repair of uv-induced damage, were tested for their effects on recombination. Pairwise crosses of rIIA cistron mutants were carried out in the presence of each ts mutation over a range of temperatures. Mutations in gene 42 (deoxycytidylate hydroxymethylase) and 43 (DNA polymerase) were shown to increase recombination. A ts mutation in gene 30 (polynucleotide ligase) also increased recombination. In the presence of ts mutations in gene 46 (nuclease) and gene 47 (nuclease) a drastic reduction in recombination is observed. Mutations in genes 41, 45, and 55 have no detectable effect on recombination. Specific roles in recombination are suggested for each of the mutations having an effect. Gene 30 (polynucleotide ligase) is necessary for repair of uv damage, and the DNA polymerase specified by gene 43 is also required for the repair of uv damage. The nucleases specified by gene 46 and gene 47 are necessary for breakdown of damaged DNA in a ligase-defective strain. A mutation designated x, which increases uv sensitivity also decreases recombination within the rII region by about 3.5-fold. A uv-sensitive mutation, designated v, altered in another gene, has no effect on recombination. As an explanation of the increased uv sensitivity of x mutant phage, the x allele may not permit a repair process that has some mechanism in common with genetic recombination. (BBB)

48278 DNA SYNTHESIS IN TEMPERATURE-SENSITIVE MUTANTS OF ESCHERICHIA COLI. Kohiyama, Masamichi (Institut Pasteur, Paris). Cold Spring Harbor Symp. Quant. Biol., 33: 317-24(1968).

From 33rd Cold Spring Harbor Symposium, Cold Spring Harbor, N. Y. See CONF-680631.

Among 300 temperature-sensitive mutants which grow at 30°C but not at 41°C isolated from Escherichia coli CR34 (a thymidine requiring mutant), five mutants were found to be incapable of synthesizing DNA at 41°C, but showed normal protein and RNA syntheses. It was demonstrated that in one mutant (CRT083) chromosome replication can occur after γ irradiation even at 41°C when DNA synthesis is otherwise stopped. This phenomenon, which is more clearly observed in the mutant than in the wild-type, suggests the participation of some accessory proteins, besides the DNA polymerase, in the control of DNA replication. An exponentially growing culture of CRT-83, when irradiated with γ rays at 10,000 R (the optimum dose which gives 50 to 100% survival), incorporated 2 to 3 times more ^{3}H-thymidine than nonirradiated cultures during 90 min incubation at 41°C. Stimulation of thymidine incorporation in irradiated cultures was accompanied by an increase of 2.5-fold in DNA content, demonstrating that irradiation allows supplementary chromosome replication. Characteristics of the DNA synthesized in the presence of 5-bromodeoxyuridine at 41°C after irradiation were examined by density centrifugation. The results indicated that γ-radioinduced replication proceeds at most for one cycle of replication and that repeated replication for a certain region of the chromosome is only possible if the bacteria

retain the ability to complete the cycle already in progress at the moment of irradiation. Because the lesions produced by γ rays are distributed randomly, chromosome replication induced by γ rays may originate at the lesions. Unlike CRT-83, the parental strain CR34 after receiving 10^4-R γ irradiation incorporated ^{3}H-thymidine less efficiently at 41°C than the nonirradiated culture. γ Rays could not induce premature replication in CR34 as efficiently as in CRT-83, if at all. To explain why the γ rays can initiate replication in CRT-83 at 41°C more efficiently than in CR34, it is proposed that in CR34 most of the DNA polymerase molecules exist in complexes with other proteins, one of which may act as initiator, in such a way that the complex is obliged to undertake the replication at a fixed locus. Therefore, although γ rays produce the accessible sites for DNA polymerase, the complex cannot initiate replication from these sites. In CRT-83, especially at 41°C, this complex may dissociate so easily, due to the modification of one of these proteins, that a modified complex can start replication from the lesions created by γ rays but not from the normal replication point. (BBB)

48279 THE FUNCTION OF T4 DNA POLYMERASE. Speyer, J. F.; Rosenberg, D. (Univ. of Connecticut, Storrs). Cold Spring Harbor Symp. Quant. Biol., 33: 345-50(1968).

From 33rd Cold Spring Harbor Symposium, Cold Spring Harbor, N. Y. See CONF-680631.

The role of a DNA polymerase of Escherichia coli infected with T4 phage in the repair of uv-induced DNA injury was investigated. The uv sensitivity of temperature-sensitive (ts) gene 43 mutants was determined. The results suggested that uv repair DNA synthesis is not the main function of T4 DNA polymerase. The effect of uv irradiation on polymerase mutagenesis was also studied. It was shown that polymerase mutagenesis must occur predominantly in processes other than uv repair. Another experiment was conducted to determine whether polymerase mutagenesis is associated with recombination. The lack of correlation of mutator-induced reversion with recombination proved that T4 DNA polymerase does not function solely as a recombinase. It was concluded that the phage-induced DNA polymerase may be required for replication, repair, or recombination, or it could be involved in all three processes. Polymerase mutagenicity was used to determine whether the enzyme is solely required for recombination or repair. The production of mutants by mutagenic polymerase cannot be accounted for by mutations arising solely during the acts of recombination and repair; therefore, the enzyme must play a direct role in replication. (BBB)

48280 SITE-SPECIFIC RECOMBINATION IN BACTERIOPHAGE λ. Signer, E. R.; Weil, Jon (Massachusetts Inst. of Tech., Cambridge). Cold Spring Harbor Symp. Quant. Biol., 33: 715-19(1968).

From 33rd Cold Spring Harbor Symposium, Cold Spring Harbor, N. Y. See CONF-680631.

The special site-specific recombination system, called Int, in bacteriophage λ and the effect of uv irradiation on it are considered. This system is present in addition to general recombination in bacteriophage λ that can be promoted by two systems that are largely independent: the host recombination system, called Rec, and a system produced at least in part by the phage, called Red. Besides general recombination, λ DNA can recombine with the host chromosome to establish stable lysogeny, probably according to the Campbell model, that is outlined. This type of recombination takes place at specific loci, called attachment regions, of the phage DNA (att^p) and bacterial DNA (att^B). The vegetative Int-promoted recombination was used to study the Int system. The observed reciprocity between the Int and Red systems in a single burst experiment indicated that the two systems act by different mechanisms. This was confirmed by the opposite effect of uv irradiation on the two types of recombination. The uv irradiation of parental phage stimulated Red-promoted recombination more than 10-fold, but decreased Int-promoted recombination more than 20-fold. Evidently the Int system produced by phage λ brings about prophage insertion and excision by promoting site-specific recombination at att. The nature of the attachment region is discussed. (BBB)

48281 GROWTH DIRECTION AND SEGREGATION OF THE E. COLI CHROMOSOME. Vielmetter, W. (Univ., Cologne); Messer, W.; Schuette, A. Cold Spring Harbor Symp. Quant. Biol., 33: 585-98(1968).

From 33rd Cold Spring Harbor Symposium, Cold Spring Harbor, N. Y. See CONF-680631.

It was shown that in different Escherichia coli Hfr strains, under conditions of vegetative growth, an integrated F^+ episome may determine the origin and direction of sequential replication. An analysis was made of mutational heterozygotes (HETs). In one experiment, HETs induced during ^{32}P suicide were shown to be converted with a certain probability into pure mutants, as ^{32}P decays. Decay of ^{32}P atoms incorporated at a sufficiently high specific activity into cells of Escherichia coli produce both lethal events and mutations. These mutations increase linearly with the fraction of ^{32}P decayed, up to more than 1% of auxotrophic mutants among the survivors of 10 lethal hits, for Escherichia coli B/r or K12 strains. Many ^{32}P-induced mutations appear as heterozygotes. For Escherichia coli B/r that even at the slow survival of 10^{-4} (corresponding to ~10 ^{32}P lethal hits) more than 50% of the mutant colonies remain sectored. This was confirmed in more extensive measurements for K12 strains. While cells are progressively killed during ^{32}P decay, the fraction of sectoring colony-formers is gradually decreased from an initially high value and reaches about 60% at nine average ^{32}P lethal hits. A model which explains the conversion of HETs during ^{32}P decay is proposed. In a second experiment the segregation of HETs induced by short pulse treatment with nitrosoguanidine was studied. Both the probability of conversion of HETs into pure mutants and the relative time of their segregation are functions of the mutant position on a sequentially replicating chromosome. This in turn provided information on the position of the origin and the direction of replication. (BBB)

48282 PARALLEL BEHAVIOR OF F AND P1 IN CAUSING INDIRECT INDUCTION OF LYSOGENIC BACTERIA. Rosner, J. L.; Kass, Leon R.; Yarmolinsky, Michael B. (National Inst. of Arthritis and Metabolic Diseases, Bethesda, Md.). Cold Spring Harbor Symp. Quant. Biol., 33: 785-9(1968).

From 33rd Cold Spring Harbor Symposium, Cold Spring Harbor, N. Y. See CONF-680631.

The role of the sex factor, F, in indirect uv induction of lysogenic bacteria and indirect induction mediated by P1 was studied. To test whether the transfer of F coincides with the transfer of the material responsible for indirect induction, time of entry experiments were conducted with males carrying either F or F-merogenotes of different size. The entry of the uv-irradiated DNA prior to F did not result in induction. These results account for the failure of Hfr donors to mediate indirect induction, and indicate that the material required for indirect induction is F. When a uv-irradiated F^+ strain was mated with an F^+ lysogenic recipient (that had been converted to a phenocopy of a female to allow conjugation), no induction was detected. Thus, an unirradiated F, whether in an autonomous or integrated state, is dominant over an irradiated F with respect to indirect induction. The F that is transferred in indirect induction is damaged in a manner that limits either its replication or its ability to function. It appeared that the ability of an unirradiated replicon to prevent induction is exercised only against its irradiated equivalent. (BBB)

48283 REPAIR OF DNA IN HAEMOPHILUS INFLUENZAE. II. EXCISION REPAIR OF SINGLE-STRAND BREAKS, DEFECTS IN TRANSFORMATION, AND HOST CELL MODIFICATION IN UV-SENSITIVE MUTANTS. Setlow, J. K.; Randolph, M. L.; Boling, M. E.; Mattingly, A.; Price, G.; Gordon, M. P. (Oak Ridge National Lab., Tenn.). Cold Spring Harbor Symp. Quant. Biol., 33: 209-18(1968).

From 33rd Cold Spring Harbor Symposium, Cold Spring Harbor, N. Y. See CONF-680631.

Seven uv-sensitive mutants of H. influenzae were studied to assess the biological role of some observable DNA repair processes, after radioinduced injury. In wild-type cells there is efficient repair of single-strand breaks in the DNA produced by the excision mechanism; at least two cistrons are probably involved in excision. Pyrimidine dimers in irradiated transforming DNA become integrated into the recipient genome. Wild-type cells repair x-ray-induced single-strand breaks in the DNA, whereas an x-ray-sensitive mutant does not. The rate of rejoining such breaks may not affect the survival of x-irradiated cells, but x-irradiated transforming DNA appears more sensitive when assayed in recipient cells that rejoin breaks in their own DNA more slowly than do wild-type cells. Thus single-strand breaks probably contribute to the inactivation of transforming DNA by x rays. Defects in the ability to be transformed were found in two uv-sensitive mutants. The defect in DB113 was correlated with filament formation, since repeated subculturing gradually eliminated the filaments and transformation was regained. DB117, which takes up DNA as efficiently as the wild type and is unable to rejoin x-ray-induced single-strand breaks, may be defective in DNA integration. All the uv-sensitive mutants show host cell modification of phage grown on these strains. There may be linkage between genes controlling uv sensitivity and host cell modification. (BBB)

48284 NUCLEASES SPECIFIC FOR ULTRAVIOLET LIGHT-IRRADIATED DNA AND THEIR POSSIBLE ROLE IN DARK REPAIR. Takagi, Y.; Sekiguchi, M.; Okubo, S.; Nakayama, H.; Shimada, K.; Yasuda, S.; Nishimoto, T.; Yoshihara, H. (Kyushu Univ., Fukuoka). Cold Spring Harbor Symp. Quant. Biol., 33: 219-27(1968).

From 33rd Cold Spring Harbor Symposium, Cold Spring Harbor, N. Y. See CONF-680631.

Evidence for enzymes involved in the dark repair of uv-induced damage in DNA was sought. Enzymes that excise pyrimidine dimers, a type of nuclease specifically active on uv-irradiated DNA, were found in extracts of Micrococcus lysodeikticus. This enzyme does not require Mg^{++} in making breaks in uv-irradiated DNA. Sedimentation analysis indicated that the breaks induced by the enzyme are single-strand rather than double-strand scissions. During the reaction with the purified endonuclease preparation, neither thymine dimers nor thymine were released from uv-irradiated DNA into the acid-soluble fraction even in the presence of Mg^{++}. When uv-irradiated DNA was incubated with the combination of the endonuclease and an exonuclease contained in a second fraction, the selective elimination of thymine dimers was observed. Thus the endonuclease in M. lysodeikticus induces a single-strand scission at a point close to a pyrimidine dimer, producing free ends susceptible to attack by an exonuclease that then removes nucleotide fragments containing dimers. A similar type of endonuclease was also found in strain 1100, an endonuclease I-negative strain of Escherichia coli. To clarify the role of these enzymes in dark repair, mutants having high uv sensitivity or possessing little endonuclease activity were isolated from both M. lysodeikticus and E. coli. However, no positive correlation between uv sensitivity and enzyme activity was established. Infection of E. coli with phage T4 induced activity that preferentially released thymine dimers from uv-irradiated DNA, whereas infection with the uv-sensitive strain T2 or the uv-sensitive mutant T4v did not. Therefore, the dimer-releasing activity induced by phage may be involved in the dark repair process. (BBB)

48285 INCREASING THE RADIORESISTANCE OF THE COLICINOGENIC STRAIN OF ESCHERICHIA COLI M-17 (V, B, E). Pershina, Z. G.; Tumanyan, M. A.; Samoylenko, I. I. (Inst. of Epidemiology and Microbiology, Moscow). Mikrobiologiya, No. 1, 103-7(1969). (In Russian).

Repeated γ irradiation of Escherichia coli M-17 (V, B, E) with sub-bactericidal doses markedly increased the radioresistance of the microbial cells. These cultures differed from the original in several respects. Ionizing radiation caused major changes in the cells and resulted in saprophytism, as shown by the loss of the ability to form gas on sugars, weakening of enzyme activity and serological activity, and change in Gram stain and form of the colonies. The increased radioresistance of the bacteria resulted in the formation of membranes around the nucleoids and in a thickening of the cell walls. Radioresistance persisted for several years after numerous subcultures. Variants with increased radioresistance retained their ability to form colonies for one or two weeks after irradiation and development of resistance. (JPRS)

48286 ULTRAVIOLET LIGHT INACTIVATION OF TOBACCO MOSAIC VIRUS. Ouchi, Seiji; Tsuda, Mitsuya (Kyoto Univ.). Mem. Coll. Agr., Kyoto Univ., No. 95, 35-46(Mar. 1969).

Ultraviolet inactivation and photoreactivation of tobacco mosaic virus (TMV) and the viral nucleic acid (TMV-RNA) were studied with the emphasis on irradiation temperature. The inactivation of both intact TMV and TMV-RNA followed the course of a first-order reaction, although some deviation was observed in the high dose range, especially above the dose that caused 96% inactivation. Post-irradiation exposure of intact TMV or TMV-RNA to visible light did not give rise to a recovery of infectivity, irrespective of the state of the irradiation sample, whether liquid or frozen. Exposure to visible light of plants inoculated with irradiated intact TMV did not give any sign of photoreactivation, irrespective of the state of the irradiation medium. The irradiated TMV-RNA, however; is definitely photoreactivable on the basis of the increased number of local lesions on Nicotiana glutinosa and Phaseolus vulgaris. The rate of inactivation of TMV-RNA was slightly higher when irradiated in dry ice suggesting that the quantum yield for the inactivation would probably be variable with the state (liquid or frozen) of the sample during irradiation. Based on these results, mechanisms of ultraviolet inactivation and photoreactivation were discussed in relation to the biological significance of dimerization of pyrimidine bases in the viral nucleic acid. (NSA of Japan)

48287 ELECTRON-MICROSCOPE STUDY OF THE EARLY STAGES IN THE INFECTION OF MONKEY KIDNEY CELLS BY SV-40 VIRUS IRRADIATED WITH UV OR GAMMA RADIATION. Ferreira-Salgado, Maria-Alice (Univ. Federal, Rio de Janeiro). Bull. Cancer, 55: 399-412(July-Sept. 1968). (In French).

The infection of monkey kidney cells with irradiated SV-40 virus was studied. Electron microscope examination carried out 3, 5, and 48 hr after infection showed that irradiated virus adsorbs on the cell surface, and penetrates into the nucleus as does control virus, but that it does not multiply. Ultraviolet radiation from a germicidal lamp with a peak output at 2537 Å was given at 115 erg/mm² sec. A dose of 27,000 erg/mm² destroyed 99% of the infectivity of the virus. A similar level (99%) of virus inactivation was provided by ^{60}Co γ radiation at a dose of 7.92 Mrad. Nucleolar hypertrophy as seen electron microscopically was used as a criterion of viral multiplication. (BBB)

48288 THE COMPARISON OF THE X-RAYS SENSIBILITIES OF THYMIDINE, TRANSFORMING DNA, AND BACTERIA. Apelgot, S.; Rebeyrotte, N. (Institut du Radium, Paris). Biophysik, 6: 25-33(1969). (In French).

Graphs are presented to show the x radiosensitivity of thymidine, DNA and bacteria. G_1 represents the value of G corresponding to thymidine irradiated with x rays at 0°C in aqueous solution; G′ is its value for thymidine irradiated under other experimental conditions. D_1 represents the value of x-ray doses that leave a 37% survival of bacteria or transforming DNA irradiated at 0°C in saline; D′ is its value under the other conditions. The graphs of the ratios G'/G_1 and D'/D_1 versus the irradiation temperatures are presented. These curves show that: the bacteria are not very sensitive to the irradiation conditions; transforming DNA is sensitive to the irradiation conditions, in the same way as thymidine; the variations of G'/D_1 or D'/D_1 with temperature is a concave upward curve in the case of thymidine, concave downward in the case of transforming DNA and bacteria. The weak dependence of the bacterial sensitivity to the modifications of the surroundings seems to be a property of the cells. The results obtained by decreasing the temperature seem to be due to the DNA of the bacteria. (auth)

Radiosterilization and Radiopreservation

Refer also to abstracts 47955 and 48008.

48289 (NYO-2043-194, pp 52-83) STERILIZATION OF THE MEDITERRANEAN FRUIT FLY AND ITS APPLICATION TO FLY ERADICATION. Katiyar, K. P.; Ramirez, E. (Inter-American Inst. of Agricultural Sciences, Turrialba (Costa Rica)).

Studies were initiated to determine the percentage of female Medflies that mate twice, with both normal and sterile males, and to study the egg fertility of such remated female flies. Sterile males were obtained from γ-irradiated (10 kR) pupae. Results indicate that when the first mating was with a normal male, a smaller percent of females (26.7%) accepted the second mating with sterile males. But when the first mating was with sterile males, a high percent of females (41.3%) mated with normal males. Thus normal males seem to be more aggressive in mating than irradiated males. The results of egg hatch experiments indicate that the influence of the second alternate mating on egg fertility of the females was higher with normal males as compared to second mating with irradiated males. A 60.4% increase in egg hatch occurred when females mated with normal males following mating with irradiated males. Further studies were also conducted on the mating competitiveness of irradiated male flies. (E.R.B.)

48290 (NYO-2043-195, pp 117-31) STUDIES ON THE BIOLOGY AND STERILIZATION OF THE COFFEE LEAF MINER, LEUCOPTERA COFFEELLA GUER. Katiyar, K.; Ramirez, E. (Inter-American Inst. of Agricultural Sciences, Turrialba (Costa Rica)).

The feasibility of the use of the sterile male technique for the control of the coffee leaf miner, Leucoptera coffeella, was investigated in laboratory studies. Data are presented on the effects of various doses of γ radiation applied at various developmental stages on the mortality and reproductive capacity of the insects. Data on the biology and ecology of the coffee leaf miner are included. The effects of 800 and 8000 R γ radiation on spermatogenesis in insects was studied in the blow fly, Phormia regina, using ^{3}H-thymidine and autoradiography to measure the rate of spermatogenesis. (C.H.)

48291 (NYO-3989-2) INVESTIGATIONS ON STERILIZATION BY IRRADIATION FOR THE CONTROL OF THE SOUTH-AMERICAN FRUIT FLY, ANASTREPHA FRATERCULUS (WIED). Technical Progress Report, April-June 1969. Gonzalez Bachini, Juan E. (Estacion Experimental Agricola de la Molina, Lima (Peru)). June 30, 1969. Contract AT(30-1)-3989. 58p. Dep. CFSTI.

Techniques and apparatus for mass breeding experiments are described. Effects of light, humidity, and temperature on eggs, larvae, pupae, and adults were studied. Following doses of 2,000 to 10,000 R of γ radiation administered to pupae, observations were made on mortality, number and viability of eggs produced by adults. The tabulated results show that complete sterility resulted

from doses above 4,000 R. A dose of 3,000 R resulted in 3 to 10% viability, while controls were 57 to 76% viable. Studies on competition between irradiated males and normal males indicated that a proportion of 50 sterile to one normal male was most effective for eliminating the possibility of fertilization of eggs laid by normal females with which they mated. Field studies included evaluation of native populations by means of trapping techniques. A relationship between the abundance of fruits such as mangos, plums, peaches, pears, and guavas and fly populations was observed. Three experimental liberations of irradiated males were carried out in order to determine flight capacity and longevity of the flies. It was observed that they survived under field conditions up to 30 days after liberation and that they could travel 200 meters from the point of liberation. (H.L.W.)

48292 (ORNL-IIC-25) PRESERVATION OF FISH BY IONIZING RADIATION: AN ANNOTATED BIBLIOGRAPHY. Weiss, F. J. McKinney, F. E.; Frye, L. M. (Oak Ridge National Lab., Tenn.). Sept. 1969. Contract W-7405-eng-26. 129p. Dep. CFSTI.

An annotated bibliography on the preservation of fish by ionizing radiation is presented. There are 331 citations included. Author and subject indexes are also included. (E.R.B.)

48293 (RISO-194) MICROBIOLOGICAL CONTROL OF RADIATION STERILIZATION OF MEDICAL SUPPLIES. II. NUMBER OF MICRO-ORGANISMS ON MEDICAL PRODUCTS PRIOR TO STERILIZATION AS A FUNCTION OF THE STORAGE TIME BETWEEN PRODUCTION AND MICROBIOLOGICAL CONTROL. Christensen, Ebbe Ahrensburg; Emborg, Claus; Holm, Niels W. (Danish Atomic Energy Commission, Risoe. Research Establishment). Apr. 1969. 12p. Dep. CFSTI (U. S. Sales Only).

Five cc disposable hypodermic syringes were contaminated with a number of different micro-organisms, and the number of surviving organisms per syringe was followed for four weeks after contamination. When stored in a dry condition, Escherichia coli was quickly inactivated, and a considerable decrease in the number of staphylococci was observed. As was expected, endospores of Bacillus subtilis withstood storage in a dry condition very well. (Sweden)

48294 (UH-235-P-5-4) DOSIMETRY, TOLERANCE, AND SHELF LIFE EXTENSION RELATED TO DISINFESTATION OF FRUITS AND VEGETABLES BY GAMMA IRRADIATION. Annual Report, June 1, 1967–May 31, 1968. Akamine, E. K.; Brewbaker, J. L.; Buddenhagen, I.; Kinch, D.; Moy, J.; Ross, E.; Spielmann, H.; Upadhya, M.; Wenkam, N. (Hawaii Univ., Honolulu. Coll. of Tropical Agriculture). Sept. 1969. Contract AT(04-3)-235. 182p. Dep. CFSTI.

Separate abstracts were prepared for each of the 15 sections on research during 1967 and 1968 at the Hawaii Research Irradiator. All were within the scope of NSA. (C.O.)

For abstracts of individual sections see: 47955–47957 and 48295–48306.

48295 (UH-235-P-5-4, pp 3-8) QUALITY EVALUATION OF GAMMA IRRADIATED PAPAYA IN SHIPPING STUDIES. Moy, J. H.; Ross, E.; Hsia, S. T.; Sawato, M. (Hawaii Univ., Honolulu. Coll. of Tropical Agriculture).

The organoleptic qualities of irradiated vs. fumigated Hawaii-grown Solo papayas were studied in the first marine and the first air shipments conducted in September, 1967 and March, 1968 respectively. The objective was to determine whether or not the fruit qualities had changed as a result of gamma irradiation and shipment handling. Results of taste panel evaluation and various objective measurements showed that qualities of both irradiated and fumigated fruits were comparable with two exceptions. One, the irradiated papayas developed a "flowery" aroma in the long marine shipment. Two, air-shipped, irradiated papayas were firmer in texture than fumigated samples at the end of 4 days. The mechanism of "flowery" aroma development is not known. The firmer texture is believed due to delayed ripening by gamma-radiation. (auth)

48296 (UH-235-P-5-4, pp 9-52) DEMAND CHARACTERISTIC FOR FRESH AND POTENTIALLY GAMMA IRRADIATED PAPAYA ON SELECTED U. S. MAINLAND MARKETS. Spielmann, Heinz (Hawaii Univ., Honolulu. Coll. of Tropical Agriculture).

An analysis of demand for papayas in two mainland markets in California was combined with a factor analysis to obtain a product profile of papayas on the mainland. Findings indicate that the demand for papayas is rather inelastic (i.e., changes in the price of the product will elicit less than proportional changes in the quantity taken off the market). Similarly, indications are that income elasticities also are relatively low indicating that changes in income have a less than proportionate effect on papaya consumption. In short, neither price nor income changes have an important effect on papaya consumption unless these changes are quite drastic. Factors that will affect papaya disappearance rate have been found to be product availability in the store, product appearance, degree of in-store promotion and store identified newspaper advertising, display attractiveness, effective quality control. The Factor Analysis based on demographic information and a Semantics Differential test (300 interviews) indicates that such attributes as taste, refreshment, appearance, nutritional value, etc., take precedence over any economic, demographic, or socio-economic considerations. It follows, therefore, that market developmental activities such as product promotion and advertising should concentrate primarily upon areas that concern themselves with taste, enjoyment, and varied usage of the products rather than any promotional activity based on demographic or socio-economic market segmentation. Gamma irradiation of papayas would have very little effect upon the demand for the product. However, sanction by the Food and Drug Administration as well as the United States Department of Agriculture will be required. Also, proper labeling of the irradiated product would be indicated. All indications point to the fact that the consumption rate of papayas in mainland markets is not anywhere near its upper limits. The market will be able to absorb considerable increases in shipment without seriously affecting the present price structure as long as an effective system of quality control is instituted and maintained. (auth)

48297 (UH-235-P-5-4, pp 53-62) PROGRAMMING AND COST ANALYSIS MODEL FOR PAPAYA PROCESSING. Kinch, D. M.; Huang, Wen-Yuan (Hawaii Univ., Honolulu. Coll. of Tropical Agriculture).

A papaya processing plant model was developed in order to study and detail possibilities of improved plant operations, plant layout, and flow patterns resulting from the additional degrees of freedom brought about by irradiation as an alternate to fumigation. (auth)

48298 (UH-235-P-5-4, pp 63-111) CONTROLLED ATMOSPHERE STORAGE FOR SHELF LIFE EXTENSION OF IRRADIATED PAPAYAS (CARICA PAPAYA L., VAR. SOLO). Akamine, Ernest K.; Goo, Theodore (Hawaii Univ., Honolulu. Coll. of Tropical Agriculture).

The following were found to be the requirements for the extension of shelf life in irradiated papayas: Initial surface color of the fruits should be color turning (ca. 6 percent yellow) to ¼-color (25 percent yellow). Fruits should be dipped in hot water for 20 minutes with the water temperature allowed to decrease from the initial 120° to 117°F, followed by cooling in running tap water for 20 minutes. Hot water-treated fruits should then be irradiated at a dose range of 75-79 krad. Irradiated fruits should then be stored at 60°F. Effect of CA (controlled atmosphere) storage under these conditions was investigated. CA storage was found to be effective for further extension of shelf life in hot water-treated irradiated fruits. In fruits stored under continually flowing CA (2 to 4 percent oxygen and 98 to 96 percent nitrogen) for 6 or 12 days, followed by storage at room temperature, the extension was approximately two days, that is, fruits stored under CA remained in a marketable condition on the average, two days longer than comparable fruits stored in air. The average shelf lives at room temperature after an initial 6-day storage period at 60°F in their respective atmospheres were 3, 6, and 8 days, for hot water-treated unirradiated fruits in air, hot water-treated irradiated fruits in air, and hot water-treated irradiated fruits in CA. For fruits initially stored for 12 days at 60°F, the respective average shelf lives at subsequent storage at room temperature for the same treatments were 0, 3, and 5 days. The feasibility of using refrigerated CA storage for the shipment of hot water-treated irradiated papayas from Hawaii to areas requiring transit period of 6 to 12 days was indicated. (auth)

48299 (UH-235-P-5-4, pp 112-14) THE INFLUENCE OF RADIATION DOSE, DEGREE OF RIPENESS, AND POST-IRRADIATION STORAGE TEMPERATURE ON THE DEVELOPMENT OF FLOWERY AROMA IN GAMMA IRRADIATED SOLO PAPAYA. Moy, J. H.; Hsia, S. T. (Hawaii Univ., Honolulu. Coll. of Tropical Agriculture).

A study was made on the development of "flowery" aroma in gamma-irradiated Solo papaya. This was detected earlier after a period of post-irradiation cold storage, and then allowing the fruit to ripen at room temperature. Results in this study showed that fruits irradiated at an initially less ripe stage tend to develop more of this "flowery" aroma as it ripens. Irradiation doses at 33, 75, and 100 krads, and post-irradiation storage at 55°, 70° and 80°F were found to have little difference in the degree of this "flowery" aroma development. (auth)

48300 (UH-235-P-5-4, pp 121-5) EFFECT OF GAMMA-RADIATION ON THE KEEPING QUALITY OF PAPAYA PUREE. Moy, J. H.; Wong, C. L. (Hawaii Univ., Honolulu. Coll. of Tropical Agriculture).

A study was made to determine if gamma-radiation could maintain or improve the keeping quality of processed fruits. Samples of Solo papaya puree irradiated at 100, 500 and 1,000 krads were compared with samples heat-pasteurized at 210°F for 1 min., all stored at 45°F or 0°F for 1 and 2 weeks. Results showed that gamma-radiation at 500 krads and 1 Mrad were more effective in retarding microbial growth than heat pasteurization when papaya puree samples were stored at 0°F and 45°F. Treatment with 100 krads was effective if the puree samples were stored at 0°F. Irradiation resulted in a tendency for off-aroma development in the puree. (auth)

48301 (UH-235-P-5-4, pp 126-35) NUTRITIONAL COMPOSITION OF IRRADIATED FRUIT. I. MANGO AND PAPAYA. Wenkam, Nao S.; Moy, Alice P. (Hawaii Univ., Honolulu. Coll. of Tropical Agriculture).

Two varieties of mango, Golden Glow and Haden, irradiated at several dose levels and stored at 45°F and 70°F for various periods were assayed for the following nutrients: moisture, total carotenoids, reduced and total ascorbic acid, and reducing sugar before and after inversion. There were no significant differences in the nutrients between the mean values of irradiated and control fruit at the dose levels studied. In the one exception, mean reduced ascorbic acid value was significantly lower in irradiated Haden mango than in the control. Simulated and marine shipment studies of irradiated and fumigated mango stored at 55°F showed vitamin values similar to those found in the 45°F and 70°F storage studies. The reduced ascorbic acid content in the irradiated papaya stored at 55°F was found to be significantly higher than in the fumigated control. The results of this study generally agree with published reports, that there is no loss in the nutritional quality at the dose levels studied. (auth)

48302 (UH-235-P-5-4, pp 136-42) ORGANOLEPTIC EVALUATION OF GAMMA IRRADIATED MANGO. Moy, J. H.; Hsia, S. T.; Sawato, M. (Hawaii Univ., Honolulu. Coll. of Tropical Agriculture).

A study was made on the organoleptic qualities of two varieties of Hawaii grown mangoes (Mangifera indica, var. Haden and var. Golden Glow). The latter variety actually is a hybrid of the Haden and the Carabao. The objective was to evaluate the color, aroma, flavor, and texture qualities of these fruits irradiated at 33 to 150 krads, which is the mango seed weevil disinfestation dose level and above. Also included were data on a trial marine shipment to California and return. Taste panel data and color measurements showed that no significant differences were detected between the fumigated control and the irradiated samples at these dose levels, with post-irradiation storage at 45°F up to 2 weeks, or in the marine shipment, 55 to 65°F up to 3½ weeks. For the purpose of seed weevil disinfestation, this study indicates that gamma irradiation could be used without any adverse effects on the organoleptic qualities of the fruit. (auth)

48303 (UH-235-P-5-4, pp 143-51) EFFECT OF LOW DOSE GAMMA IRRADIATION AND STORAGE ON THE THIOBARBITURIC ACID VALUES AND -SH CONTENTS OF PIRIE MANGOES. Upadhya, Mahesh D. (Hawaii Univ., Honolulu. Coll. of Tropical Agriculture).

Thiobarbituric acid values (TBA) and total -SH content were made of irradiated Pirie mangoes. Fresh fruits were irradiated with 25, 50, 75 and 100 krads of gamma irradiation. The edible flesh was analyzed for the TBA values and -SH content immediately following irradiation (D_0) after one day of storage at 45°F (D_1) and after 6 days of storage at 70 to 75°F. Optical density data were converted into percentages of controls and analyzed statistically. TBA values showed significant differences among the doses used, and increased with dose and time of storage. There were significant differences among the doses used for the -SH content. The data have been discussed in relation to providing a measure of radiation effect at the low disinfestation doses used. (auth)

48304 (UH-235-P-5-4, pp 152-6) ORGANOLEPTIC EVALUATION OF GAMMA IRRADIATED PINEAPPLE. Moy, J. H.; Hsia, S. T.; Sawato, M. (Hawaii Univ., Honolulu. Coll. of Tropical Agriculture).

A study was made on the organoleptic qualities of two varieties of Hawaii-grown pineapples. The Smooth cayenne is an established commercial variety requiring no treatment for interstate shipment from Hawaii. The Hybrid Variety-A, promising but still experimental, will require fumigation if commercialized. The objective of the study is to evaluate the color, aroma, flavor and texture qualities of these fruits when irradiated in the region of a disinfestation dose level and above, 25 to 200 krads, and to determine if a limiting dose level could be defined for the wholesomeness of the fruit. Taste panel results showed that no significant differences were detected between the non-fumigated control and irradiated samples up to 200 krads for the Smooth cayenne and 150 krads for the Hybrid Variety-A. Post-irradiation storage at 45°F, 75 to 85% R.H., from 5 to 12 days showed no chilling injury. For the purpose of fruitfly disinfestation of potential new commercial varieties of pineapple, and from the quality standpoint, this study indicates that gamma irradiation could be the substitute for fumigation. (auth)

48305 (UH-235-P-5-4, pp 157-62) NUTRITIONAL COMPOSITION OF IRRADIATED FRUIT. II. PINEAPPLE. Wenkam, Nao S.; Moy, Alice P. (Hawaii Univ., Honolulu. Coll. of Tropical Agriculture).

Two varieties of pineapple, Smooth Cayenne and Hybrid A, γ irradiated at several dose levels and stored at 45°F and 70°F for various periods were assayed for the following nutrients: moisture, total carotenoids, reduced and total ascorbic acid. There were no significant differences between the mean values of irradiated fruits and control fruits in the nutrients at the dose levels studied. In the one exception, mean reduced ascorbic acid value in irradiated Hybrid Variety A pineapple was significantly lower than in control fruit. The results of this study are generally in agreement with published reports, that there is no loss in the nutritional quality at the dose levels studied. (auth)

48306 (UH-235-P-5-4, pp 163-8) ORGANOLEPTIC EVALUATION OF GAMMA IRRADIATED LYCHEE. Moy, J. H.; Chang, G. K. L.; Hsia, S. T. (Hawaii Univ., Honolulu. Coll. of Tropical Agriculture).

A study was made on the organoleptic qualities of six varieties of Hawaii grown lychee (Litchi chinensis Sonn.). The objective is to evaluate the color, aroma, flavor and texture qualities of these fruits when irradiated at 50 to 100 krads, which is the dose level for fruit fly disinfestation and slightly above. Taste panel results showed that no significant differences were detected between the non-fumigated control and irradiated samples following post-irradiation storage at 45°F up to 3 weeks. Data on percent decay also indicate gamma-irradiation might be effective in delaying the ripening of the fruit. For purpose of fruit fly disinfestation, this study indicates that gamma irradiation could be used without any adverse effects on the organoleptic qualities of the fruit. (auth)

48307 RADIOSTERILIZATION OF MEDICAL SUPPLIES. Sunada, Tsuyoshi (Osaka Prefectural Radiation Center). Ikakikaigaku Zasshi, 39: 409-17(May 1969). (In Japanese).

Radiosterilization of medical equipment and supplies has the following advantages: little generation of heat makes this method suitable for the materials which are easily damaged by heat; high permeability enables sterilization from the outside of sealed materials; and the method provides continuous management of sterilization. Its disadvantages consist in the economical aspects. Since a large dose of radiation for sterilization endangers the human body to a considerable extent, safety supervision and facilities for protection become indispensable. The installation of sterilization equipment is also costly. The irradiation effect is, as a rule, cumulated each time the sterilization is conducted, giving changes in the quality of the materials of certain types. Accordingly, radiosterilization is suitable for supplies which are used and abandoned. The radiation dosage varies depending upon the microorganisms' type, density, environment, and the degree of resistance to radiation. The supplies to be sterilized should be given microbiological and the physicochemical tests in advance in order to investigate their fitness for radiosterilization. It is also necessary to examine the toxicity of the chemical substances produced in the irradiated supplies by radiochemical changes. The materials for packing need to be of such nature and structure as to maintain sterility even after irradiation. (NSA of Japan)

48308 GAMMA IRRADIATION FOR CONTROL OF DISEASES IN STORED APPLES. Terui, Mutsuo; Harada, Yukio (Hirosaki Univ., Aomori, Japan). Hirosaki Daigaku Nogakubu Gakujutsu Hokoku, No. 15, 21-31(Mar. 1969). (In Japanese).

Fundamental studies on the effect of ^{60}Co γ irradiation on control of diseases of stored apple fruits were carried out. Mycelia and/or conidia of the several apple fruit-rotting fungi (Penicillium expansum, Monilinia fructigena, Glomerella cingulata, Botrytis cinerea, Cephalothecium roseum, and Monilinia fructicola) were irradiated with the doses of 100, 200, 500, 1000, 1500, and 2000 K rads, using two different dose rates, 100 K rad/hr and 1000 K rad/hr, in each dose. After irradiation, the colony-forming potential of the mycelia and conidia was determined by transferring them onto potato saccharose agar plates and incubating the plates for more than 10 days at 20 to 23°C. Apple fruits (variety Jonathan 7 days after harvest) inoculated with P. expansum (blue mold fungus) or M. fructigena (brown rot fungus) were irradiated with 100, 200, and 500 K rads at

the dose rate of 100 K rad/hr. The irradiated apple fruits were thereafter stored at 0 to 1°C and investigated concerning the decay development for about 4 months. Uninoculated fruits were also used, that were irradiated with 100 K rad and thereafter stored at 13 to 17°C for 41 days, to investigate as to the occurrence of physiological disorders. The results obtained are as follows: In the case of two dose rates, 100 K rad/hr and 1000 K rad/hr, minimal doses of γ radiation required to lose colony-forming potential of the fungi tested, were 500 to 1000 K rads in the mycelia and 200 to 500 K rads in the conidia. In hanging drop cultures, some conidia irradiated with 500 K rad or more produced germ tubes, except P. expansum, regardless of dose rate. Sterilizing or fungistatic effect of γ irradiation evidently varies with dose rates. With the irradiation of 100 K rad and 200 K rad, the development of fruit decay by P. expansum was retarded about 10 days and 30 days, respectively. In the case of the fruits inoculated with M. fructigena, the decay development was retarded respectively about 5 days and 50 days by the irradiation of 100 K rad and 200 K rad. Irradiation of 100 K rad on the apple fruits inhibited to some extent the occurrence of Jonathan spot and Jonathan freckle but promoted internal breakdown when the fruits were stored at 13 to 17°C. Injuries by γ irradiation of apples stored after irradiation at 0 to 1°C, such as cracking or softening of pulp, were not observed on the fruits in the 100 K and 200 K rad lots, but were evident in the 500 K rad lot after about 2 months of storage. Further studies are needed on finding the practical dose of ^{60}Co γ irradiation for prevention of decay development in the stored apple fruits without inducing irradiation injuries on them. (NSA of Japan)

48309 EFFECT OF ^{60}Co GAMMA RADIATION ON FRESHNESS OF PEAR. Okamoto, Tatsuo; Horitsu, Keisuke (Hirosaki Univ., Aomori, Japan). Hirosaki Daigaku Nogakubu Gakujutsu Hokoku, No. 15, 32-7(Mar. 1969). (In Japanese).

A study of the effects of low dose ^{60}Co γ irradiation on the storage life of fresh pears was conducted. The tendency for after-ripening was inhibited in the 300 K rad irradiated fraction. On the other hand, after-ripening was accelerated slightly in the 5 K rad and 10 K rad irradiated fractions as compared with the non-irradiated fraction. Determinations of organoleptic properties, surface color change, specific gravity, respiration, flesh firmness, pH, acidity, pectin-like substances, vitamin C, and nitrogen fraction were used to evaluate the effects. (NSA of Japan)

48310 INHIBITION OF GERMINATION OF POTATOES BY GAMMA IRRADIATION. Com. Naz. Energ. Nucl., Notiz., 15: No. 2, 90-2(Feb. 1969). (In Italian).

The irradiation of potatoes with γ ray doses of 8 to 10 krad had the effect of inhibiting the germination and preventing the multiplication of the germinal cells of the potato. The irradiation did not cause injurious residues. The commercial value of this treatment is indicated. (J.S.R.)

48311 RADIATION STERILIZATION OF MEDICAL DEVICES AND SUPPLIES. 6. DISPOSABLE SYRINGES AND NEEDLES. Sato, Kenji (Tokyo Metropolitan Isotope Research Center); Urakubo, Goro. Eisei Kagaku, 15: No. 1, 22-5(Feb. 1969). (In Japanese).

Disposable polystyrene and polypropylene syringes (Jintan Co.) and needles, that were stored for 24 months after irradiation with ^{60}Co γ rays at 3 Mrad for the purpose of sterilization, were subjected to sterility tests and function tests, such as load test, fluid tightness test, and test of solubility in physiological saline solution. There was no bacterial recontamination of the samples and no detrimental effects on the function of the polystyrene or polypropylene syringes. It was observed that, in a certain polypropylene material, irradiation caused a slight coloring and brittleness due to decrease of molecular weight. It is suggested, therefore, that a suitable selection of material is important for the application of sterilization technology to disposable medical supplies. (NSA of Japan)

48312 EXPERIMENTAL EXPERIENCES WITH THE COLLAGEN SPONGE AS HEMOSTATICUM AND TAMPON. Chvapil, M; Holusa, R. (Inst. of Industrial Hygiene and Occupational Diseases, Prague). J. Biomed. Mater. Res., 2: 245-64(June 1968).

Experimental data for the preparation of a collagen sponge to be used as hemostaticum or tampon were summarized. Optimal conditions were found with respect to the degree of porosity and tanning of the sponge in order to attain both these properties separately. The native sponge partially ages by storage and its stability increases with increase of temperature during storage. The heat-induced stability of the sponge, however, is not as great as the stability induced by tanning agents. No effect of ^{60}Co irradiation on the stability of the collagen sponge was found within doses of 1 to 10 Mrad. The speed of resorption and tissue reaction of the subcutaneously implanted native and tanned collagen sponge was followed up and no hypersensitive reaction by the tissue was found. However, different reactions of the tissue to native and to tanned sponge were ascertained. (auth)

48313 TISSUE TOLERANCE OF DIFFERENTLY STERILIZED PLAIN CATGUT. Dittrich, Herbert (Univ., Erlangen, Ger.). Bruns. Beitr. Klin. Chir., 216: 359-63(June 1968). (In German).

Threads of catgut- and mersilene-fibers (polyester fibers) were tested as to their tissue tolerance. Following sterilization with ethylene oxide or irradiation, implants into the musculature of rabbits were examined histologically. The results were evaluated statistically with a proved scoring system. Examination was carried out after 3, 5, 15, and 30 days of implantation. It could be shown that under the test conditions catgut sterilized by irradiation as well as that treated with ethylene oxide did not exhibit different tissue reactions. Both showed a good tissue compatibility. In the first 15 days mersilene showed a significantly lesser tissue reaction compared with catgut. (auth)

METALS, CERAMICS, AND OTHER MATERIALS

Metals and Alloys

Refer also to abstract 47423.

48314 (BNL-50190) HIGH-TEMPERATURE LIQUID-METAL TECHNOLOGY REVIEW. A Bimonthly Technical Progress Review. Volume 7, Number 3. (Brookhaven National Lab., Upton, N. Y.). June 1969. 117p. Dep. CFSTI.

Information on research and development in the U. S. on high temperature liquid-metal technology is reviewed. Information is summarized on physical properties and thermodynamics, fluid dynamics, heat transfer, corrosion and erosion, instrumentation, component development, systems studies, chemistry, fabrication, and safety. (auth)

48315 (ORNL-4420) FUELS AND MATERIALS DEVELOPMENT PROGRAM. Quarterly Progress Report for Period Ending March 31, 1969. Patriarca, P. (comp.) (Oak Ridge National Lab., Tenn.). Aug. 1969. Contract W-7405-eng-26. 270p. Dep. CFSTI.

Research and development is summarized in fifteen sections. A separate abstract was prepared for each section. (J.R.D.)

For abstracts of individual sections see: 47717, 48324, 48348–48351, 48388, 48389, 48499, 48502–48504, 48528, 48574, and 48575.

48316 REFRACTORY METALS AND ALLOYS IV. RESEARCH AND DEVELOPMENT. VOLUME I. Based on the Proceedings of a Technical Conference, French Lick, Ind., October 3–5, 1965. Jaffee, R. I.; Ault, G. M.; Maltz, J.; Semchyshen, M. (eds.). Met. Soc. Conf., 41: 1-758(1967). (CONF-651025-(Vol.1)).

Thirty-nine papers are included in Volume I. A separate abstract was prepared for each of 29 papers. Ten papers were previously abstracted in NSA as 20: 13263, 20: 21250, 20: 21404, 20: 21405, 20: 21406, 20: 21407, 20: 21410, 20: 21411, 20: 21412, and 20: 37274. (J.R.D.)

For abstracts of individual papers see: 48360, 48366–48368, 48401–48421, 48469, 48474, 48479, and 48537.

48317 REFRACTORY METALS AND ALLOYS IV. RESEARCH AND DEVELOPMENT. VOLUME II. Based on the Proceedings of a Technical Conference, French Lick, Ind., October 3–5, 1965. Jaffee, R. I.; Ault, G. M.; Maltz, J.; Semchyshen, M. (eds.). Met. Soc. Conf., 41: 761-1338(1967). (CONF-651025-(Vol.2)).

Thirty papers are included in Volume II. A separate abstract was prepared for each of 26 papers. Three papers were previously abstracted in NSA as 19: 30683, 20: 2336, and 20: 21283. (J.R.D.)

For abstracts of individual papers see: 48330–48341, 48363–48365, 48422–48428, and 48475–48478.

48318 PROPERTIES OF REFRACTORY METALS. Wilkinson, Walter D. American Society for Metals and U. S. Atomic Energy Commission Monograph. New York, Gordon and Breach Science Publishers Inc., 1969. 363p. $18.00. (TID-25189).

Information concerning the effects of fabrication, treatment, and composition on the properties of refractory metals and alloys is presented in eight chapters. A separate abstract was prepared for each chapter. (J.R.D.)

For abstracts of individual chapters see: 48344, 48379, 48447, 48449–48452, and 48492.

Corrosion and Erosion

Refer also to abstracts 48361, 48363, 48377, and 48492.

48319 (ANL-7505) CORROSION OF VANADIUM AND VANADIUM-BASE ALLOYS IN SODIUM. Ruther, W. E. (Argonne National Lab., Ill.). May 1969. Contract W-31-109-eng-38. 39p. Dep. CFSTI.

Vanadium and certain stronger vanadium-base alloys (V–5 wt % Cr, V–10 wt % Cr, V–15 wt % Cr–5 wt % Ti, V–15 wt % Ti–7.5 wt % Cr, and V–20 wt % Ti) were exposed to sodium cold-trapped at two temperatures (~110 and 175°C). The temperatures of exposure varied from 450 to 700°C. Linear rates of weight loss were noted at the higher impurity level in the sodium (cold trap ~175°C). Under optimum conditions, very low weight and dimensional changes were noted for vanadium and the vanadium–chromium binary alloys after exposure in sodium cold-trapped at ~110°C. Results of postexposure chemical analyses indicated that oxygen was the major impurity transferred to the vanadium alloys. Titanium as an alloying additive caused increased impurity pickup and concentrated the impurities in a subsurface band 10 to 100 μm thick. The vanadium–chromium binary alloys were the most corrosion-resistant at the lower cold-trap temperature and appeared to offer promise as a reactor fuel cladding. (auth)

48320 (GEMP-573(Rev.)) EVALUATION OF THE POTENTIAL OF SELECTED ALLOYS FOR USE AS A FUEL CLADDING MATERIAL IN AN LMFBR. Collins, C. G.; Moteff, J.; Chandler, B. A. (General Electric Co., Cincinnati, Ohio. Missile and Space Div.). Initially Issued Nov. 1967; Final Issue June 1969. Contract AT(40-1)-2847. 312p. Dep. CFSTI.

An evaluation is presented of the potential of various classes of alloys for use as the fuel cladding material in a liquid metal cooled, fast breeder reactor. The evaluation is based on reviews of the data on the sodium corrosion resistance, nuclear characteristics, irradiation effects, and creep or creep-rupture properties. The materials considered include the alloys of iron, nickel, cobalt, vanadium, niobium, molybdenum, tantalum, and tungsten. It was concluded that the alloys of immediate potential are the austenitic steels and the Fe–Cr–Co–Ni alloys and that those with development potential offering higher creep strengths include the nickel alloys with less than ~50 percent nickel, and the cobalt, vanadium, molybdenum, and niobium alloys. The ferritic steels, nickel alloys with greater than ~50 percent nickel, and the tantalum and tungsten alloys are classified as of limited interest. Irradiation effects are considered the most important problem area for all of the alloy classes. Other limitations noted include the strength of the austenitic steels, the ductility of the cobalt alloys, corrosion of the nickel, vanadium, and niobium alloys, and the nuclear characteristics of niobium and molybdenum alloys. (auth)

48321 (IN-1191) PERFORMANCE OF TITANIUM AND NIOBIUM ELECTRODES IN AN ELECTROLYTIC DISSOLVER FOR NUCLEAR FUELS. Butzman, R. G.; Kertamus, N. J. (Idaho Nuclear Corp., Idaho Falls). Aug. 1969. Contract AT(10-1)-1230. 15p. Dep. CFSTI.

Corrosion measurements revealed that titanium could be used, with low corrosion rate, as the cathode-container for an electrolytic dissolver for nuclear fuels operated with 6M or greater nitric acid. The corrosion rate for titanium decreased with increasing nitrate ion concentration at constant current density and increased with increasing current density. The anodic current-potential characteristics of the valve metals niobium and tantalum were studied in nitric acid. Both the current flow and the corrosion rate, even at 50 volts and 55°C, were low enough to permit the use of either metal as a support for the active platinum anode in the dissolver. (auth)

48322 (IS-T-318) CORROSION OF A LOW ALLOY STEEL IN A SIMULATED LIQUID-METAL-FUEL REACTOR MIXTURE. Suchanek, Roger Lee (Ames Lab., Iowa). Mar. 1969. Contract W-7405-eng-82. 77p. Dep. CFSTI.

Thesis.

An isothermal, dynamic testing technique was used to investigate the effectiveness of zirconium as an inhibitor to the corrosion of 2¼% Cr-1% Mo alloy steel by liquid lead–bismuth eutectic (55.5% bismuth), compounded to simulate the liquid metal medium which would be found in a liquid-metal fueled reactor. The 96-hour tests were conducted in the temperature range of 500 to 900°C, and evaluation of the corrosion resistance was made on the basis of the amounts of iron and chromium appearing in the melt during exposure, and on metallographic examinations of the test specimens after exposure. Chromium was selectively removed from the steel by pure lead–bismuth eutectic, particularly at the higher temperatures. The low alloy steel was resistant to attack up to a temperature of 700°C with extensive intergranular attack occurring above that temperature. Under inhibited conditions in the simulated reactor mixture the low alloy steel was resistant to attack up to 800°C. At this temperature the amounts of iron and chromium removed from the alloy were reduced by factors of 30 and 6, respectively, when compared to the pure eutectic runs. No intergranular attack was observed at 800°C. This increase in corrosion resistance is thought to be due to the formation of a protective film on the surface of the steel. At 900°C the corrosion resistance of the steel decreased. Metallographic examination of the specimens tested at 900°C showed a finger-like structure on the surface of the metal. The cause of this structure is unknown. (auth)

48323 (N-69-32032) ADVANCED REFRACTORY ALLOY CORROSION LOOP PROGRAM. Quarterly Progress Report, Jan-

uary 15–April 15, 1969. Harrison, R. W. (General Electric Co., Cincinnati, Ohio. Nuclear Systems Programs). May 16, 1969. Contract NAS3-6474. 29p. (NASA-CR-72560; GESP-258). CFSTI.

A description is given of part of a task to fabricate, operate for 10,000 hours, and evaluate a T-111 Rankine system corrosion test loop. Materials for evaluation include the containment alloy T-111 (Ta-8W-2Hf) and the turbine candidate materials Mo-TZC and Cb-132M which are located in the turbine simulator of the two-phase potassium circuit. The compatibility of the materials was evaluated at conditions representative of space electric power system operating conditions. Start-up and operations of the test loop are described. Data on loop temperatures, boiler conditions, boiling stability, and partial pressure tests of the chamber are presented reflecting conditions after 2000 hours of operation. Tests of advanced tantalum alloy capsules of the ASTAR 811-type (Ta-8W-1Re-1Hf) in lithium are also mentioned. (STAR)

48324 (ORNL-4420, pp 89-115) ALKALI-METAL CORROSION STUDIES. Harms, W. O.; DeVan, J. H.; Litman, A. P. (Oak Ridge National Lab., Tenn.).

The dependence on time of the interaction of 0 with V in Na at 600°C was evaluated. The tests were conducted in both Mo and stainless steel capsules for 100 to 500 hr. With either type capsule, the 0 uptake by $\frac{1}{16}$-in. V coupons increased with exposure time up to 300 hr and then leveled off. A thermal convection loop test was started in which unalloyed V serves directly as the heated section. The ratio of the surface areas of V and stainless steel is 0.24. The loop will operate with Na low in 0 content for 3000 hr at 700°C maximum temperature. A vacuum furnace was installed to study the reaction of V alloys with residual gases in vacuum. The interstitial concentrations of specimens of unalloyed V did not change significantly after 810 hr in this diffusion-pumped system at 3×10^{-8} torr. Studies were continued on the scaling of stainless steels at elevated temperature in moist and dry air as affected by the presence of thermal insulations. Initial experiments were conducted on stainless steel and insulation couples to establish reference data for future studies involving leaks of Na. The oxidation rate of machined surfaces of type 316 stainless steel was significantly lower than that of pickled surfaces. Oxidation rates for pickled type 304L stainless steel approached that for specimens of type 316 stainless steel as machined. The presence of a $SiO_2-Al_2O_3$ insulating material had little effect on oxidation over the temperature range studied (730 to 815°C). A small increase in scaling was noted, however, in the case of an asbestos-base material. The effect of 0 on the compatibility of Ta with Na was evaluated at 600°C. Tantalum exposed to Na containing 50 to 2000 ppM O gained weight and exhibited an apparent oxide scale. Additions of 0 to the Ta before test led to severe penetration of the Ta by Na. The potential sources of error in the gettering-vacuum-fusion technique used to determine the O content in Na or K was evaluated. Transfer of O from the Mo capsule to the Zr specimen contributes a blank of about 10 ppM. Handling steps involved in encapsulating the alkali metals make a negligible contribution. Bend tests were conducted at room temperature to measure the ductility of specimens of T-222 sheet that had been contained in a T-222 thermal convection loop that circulated Li for 3000 hr at 1350°C. Specimens from an intermediate-temperature zone (1220 to 1280°C) were relatively brittle, while those from either hotter or colder regions were considerably more ductile. Aging temperature appeared to have a more significant effect on ductility than the interstitial changes produced by the Li. The assembly of T-111 forced circulation loop (FCLLL-1) designed to circulate Li at 1370°C is almost complete. A leak check of the loop after it was mounted in the vacuum chamber revealed a crack near an internal weld that anchored a specimen assembly. The crack was successfully repaired by overlaying it with Nb–1% Zr filler metal. (auth)

48325 (ORNL-tr-2190) EFFECT OF NICKEL, SILICON, AND MOLYBDENUM ON THE CORROSION OF AUSTENITIC IRON–CHROMIUM–NICKEL ALLOYS IN SUPERHEATED STEAM. Coriou, H.; Grall, L.; Mahieu, C.; Peiras, M.; Perez, A. Translated by R. Gregg Mansfield (Oak Ridge National Lab., Tenn.), from Mem. Sci. Rev. Met., 65: 643-50(1968). 9p. (CONF-670666-1). Dep. CFSTI.

From Meeting on Special Steels, Toulouse, France.

An abstract of this paper, prepared from the original language, appeared as NSA 23: 10168.

48326 (UCRL-50511) LIQUID-METAL CORROSION EXPERIMENTS: THE PUMPED CAPSULE. Rozsa, Rudolf B. (California Univ., Livermore. Lawrence Radiation Lab.). Dec. 2, 1968. Contract W-7405-eng-48. 29p. Dep. CFSTI.

The pumped capsule was designed to study the dynamic corrosion of materials used to contain liquid-metal coolants in space-power nuclear reactors. The pumped capsule consisted of a closed tube containing a splitter plate which separated the tube into two channels. The channels join at the ends of the tube to form a closed loop. The liquid metal was circulated in the capsule by an electromagnetic conduction pump. Radiant heating of one end of the capsule and radiation cooling of the other simulated the operation of a liquid-metal coolant loop. In the experiments, liquid lithium was circulated in W–Re–Mo alloys at temperatures to 1650°C for times as long as 1000 hr. Little corrosion damage was observed. (auth)

48327 CORROSION STUDIES ON Al–9 PERCENT Si–1 PERCENT Ni ALLOY IN HIGH TEMPERATURE WATER. Gnanamoorthy, J. B.; Balachandra, J. (Bhabha Atomic Research Centre, Bombay). Trans. Indian Inst. Metals, 22: No. 1, 67-9(Mar. 1969).

Results of corrosion studies on Al-9% Si-1% Ni exposed to high purity water are reported. It was found that after an initial high rate of corrosion the process slowed to a relatively low rate. The formation of a duplex oxide layer structure appears to be a factor in favor of increased oxidation resistance. (J.R.D.)

48328 STABILITY OF MOLYBDENUM GERMANIDES IN AIR AND IN OXYGEN. Biryukova, R. S.; Popova, O. I. (Inst. of Problems in Study of Materials, Kiev). Dopov. Akad. Nauk Ukr. RSR, Ser. B, No. 7, 624-7(July 1969). (In Ukrainian).

The stability of molybdenum germanides $MoGe_2$, $Mo_{13}Ge_{23}$, Mo_5Ge_3 and Mo_3Ge was investigated in air and oxygen at 200 to 1000°C. It was established that the decomposition of molybdenum germanides in air and oxygen occurs with the formation of germanium dioxide and molybdenum oxide. The oxidation begins in air and oxygen at 800 and 700°C respectively. The stability rises with an increase of the germanium content in germanide. (auth)

48329 NEW CAST ACID-RESISTANT STEELS AND ALLOYS. Nikiforova, V. M.; Reshetkina, N. A. Khim. Prom., No. 10, 780-4(1968). (In Russian).

The corrosion resistance of some 46 steels and alloys was studied at temperatures up to 90°C in 10, 20, and 40% H_2SO_4 and in 10, 20, and 37% HCl. For cast machine equipment and plant to operate in up to 40% H_2SO_4 and up to 90°C without abrasion the steels Kh8N18M6D5S5 [8:18:6:5:5 Cr–Ni–Mo–Cu–Si] and Kh18N16D1.5 [18:16:1.5 Cr–Ni–Cu] are recommended: these steels have a good corrosion resistance (<0.35 g/m²hr) in these conditions. Steels recommended for H_2SO_4 production and subjected to tensile stresses but not operated in conditions of abrasion are Kh22N46M6D5 [22:46:6:5 Cr–Ni–Mo–Cu] and Kh22N46M6D5S6 [22:46:6:5:6 Cr–Ni–Mo–Cu–Si]: these steels are based on Kh20N45B [20:45 Cr–Ni, Nb-stabilized] and have corrosion rates of <0.2 and 0.3 g/m²hr respectively. They are not susceptible to corrosion cracking in chloride solutions. In H_2SO_4 of up to 40% and temperature up to 50°C where abrasive conditions exist, the alloys N60M28S10 [60:28:10 Ni–Mo–Si], Kh15N55M16D5S10 [15:55:16:5:10 Cr–Ni–Mo–Cu–Si], and N55M28D5S10 [55:28:5:10 Ni–Mo–Cu–Si] are recommended: corrosion rates are <0.1, 0.06, and 0.01 g/m²hr, respectively and HRC up to 55, 46, and 51, respectively. The latter material is also suitable for operation up to 90°C at which temperature the corrosion rate is >0.2 g/m²hr. The alloy N65M28D5 [65:28:5 Ni–Mo–Cu] is recommended for cast components operating without abrasion in hot HCl at all the concentrations studied, it had a test corrosion rate of <0.6 g/m²hr. (Referativnyi Zh.)

48330 OXIDATION AND EMBRITTLEMENT IN SILICIDE-COATED COLUMBIUM ALLOY AND ALUMINIDE-COATED TANTALUM ALLOY SHEET. Stein, B. A.; Lisagor, W. B. (Langley Research Center, Hampton, Va.). Met. Soc. Conf., 41: 983-98(1967).

From Symposium on Physical Metallurgy of Refractory Metals, French Lick, Ind. See CONF-651025-(Vol.2)).

Results of investigations on Cr–Ti–Si (silicide) coated Nb–10Ti–5Zr alloy sheet indicated that at 2400°F the coated sheet exhibited lifetimes longer than 150 hours in static airflow oxidation tests for 1-hour cyclic exposures and longer than 1 hour in dynamic airflow oxidation tests for 6-minute cyclic exposures. This degree of protection may be adequate for some applications in thermal protection systems. During cyclic exposure at atmospheric and reduced pressures, severe substrate embrittlement prior to coating failure was noted at temperatures as low as 2000°F. This embrittlement appears to be caused by permeation of oxygen through microscopic cracks in the coating, diffusion throughout the substrate along grain boundaries, and formation of embrittling networks of zirconium oxide precipitates along grain boundaries. Test results for Al–Sn–Mo (aluminide) coated Ta–10W alloy sheet indicated that the coated sheet exhibited lifetimes in excess of 5 hours in static air oxidation tests for 1-hour cyclic exposures at 2900°F and atmospheric pressure. However,

indications of coating evaporation were noted in reduced pressure tests at 2300°F. Oxidation data at atmospheric pressure indicated lower coating lifetimes for the aluminide coating with 5.5 percent molybdenum. This was apparently due to flowing action in a liquid layer in the coating, produced by the shearing action of the air-stream. Test results on a modified aluminide coating containing 7 percent molybdenum indicated longer lifetimes in dynamic oxidation tests. No severe embrittlement was noted in Ta–10W alloy bend tests after high-temperature exposures, but loss of substrate thickness due to solid-state diffusion during high-temperature exposures could limit the applicability of the coated-tantalum-alloy sheet when thin foils are utilized. (auth)

48331 FUSED SLURRY SILICIDE COATINGS FOR THE ELEVATED TEMPERATURE OXIDATION OF COLUMBIUM ALLOYS. Priceman, S.; Sama, L. (Sylvania Electric Products, Inc., Hicksville, N. Y.). Met. Soc. Conf., 41: 959-82(1967).

From Symposium on Physical Metallurgy of Refractory Metals, French Lick, Ind. See CONF-651025-(Vol.2)).

The development of a silicide coating process that approximates the demonstrated protectiveness of the better coatings now available is discussed. The data presented indicate that as regards overall demonstrated performance as measured by high and low temperature oxidation resistance, slow cyclic oxidation resistance, resistance to degradation by low pressure, high temperature environments, and retention of base metal mechanical properties, the fused silicide coatings are equal to or superior to all other coatings for niobium alloys. There is reason to believe that the protective properties demonstrated for the fused silicide coatings are readily achievable in large, complex, usable parts and structures, while it has not been demonstrated, nor does it seem reasonable to assume, that the same is true of other coatings because of the nature of the coatings or their application processes. (J.R.D.)

48332 AN ELECTRON MICROPROBE ANALYSIS OF THE Cr–Ti–Si COATING SYSTEM ON COLUMBIUM. Gadd, J. D. (Thompson Ramo Wooldridge, Inc., Cleveland). Met. Soc. Conf., 41: 919-41(1967).

From Symposium on Physical Metallurgy of Refractory Metals, French Lick, Ind. See CONF-651025-(Vol.2)).

An analysis is presented of the mechanisms associated with diffusion and protective effects of Cr–Ti–Si coatings on niobium. Electron and light microscopy results are interpreted along with those obtained by x-ray diffraction and electron microprobes. Oxidation behavior is evaluated as related to coating deposition process parameters. (J.R.D.)

48333 AN EMITTANCE IMPROVEMENT TOPCOAT FOR DISILICIDE-COATED TZM MOLYBDENUM ALLOY. Gunderson, J. M.; Lindh, D. V.; Krier, C. A. (Boeing Co., Seattle). Met. Soc. Conf., 41: 999-1017(1967).

From Symposium on Physical Metallurgy of Refractory Metals, French Lick, Ind. See CONF-651025-(Vol.2)).

A TiC topcoat is described which provides a stable high emittance coating for disilicide coated TZM when exposed to conditions simulating an entry environment with peak temperatures up to 3000°F. No effect of the TiC topcoat on the oxidation protective capability of disilicide coated TZM was observed. The adhesion of the topcoat to the disilicide coating on TZM is good in both bending and vibration tests. No effect of weathering was observed on TiC disilicide coated TZM. The emittance of the TiC topcoat on disilicide coated TZM is dependent upon the exposure temperature and pressure. The emittance of the TiC topcoat on disilicide coated TZM was relatively unaffected by time at constant pressure within the range of the variables investigated. The TiC topcoat has utility for other disilicide coated refractory alloys. (auth)

48334 PERFORMANCE OF COATED REFRACTORY METALS IN LOW-PRESSURE ENVIRONMENTS. Packer, C. M.; Perkins, R. A. (Lockheed Missiles and Space Co., Palo Alto, Calif.). Met. Soc. Conf., 41: 1045-53(1967).

From Symposium on Physical Metallurgy of Refractory Metals, French Lick, Ind. See CONF-651025-(Vol.2)).

Results of investigations of protective coatings revealed that coated refractory metals are useful over a broad range of temperature and pressure. Commercially available silicide-base coatings for Mo- and Nb-base alloys can be exposed to air at pressures of 0.01 to 50-mm Hg for 4 hr at 2550 to 2650°F without random failure. This conclusion is based on the performance of high-quality samples that were representative of optimum manufacturing practices for each system. The oxidation resistance of silicide-base coatings (for Nb and Mo) is degraded in air at reduced pressure. Minimum performance capabilities exist for all systems at pressures of 0.01- to 1.0-mm Hg. The maximum temperature for a given life to failure in this range is essentially the same for all systems, independent of variations in coating and substrate composition and in manufacturing processes. (auth)

48335 COMPOSITIONAL AND STRUCTURAL IN IDENTIFICATION OF PROTECTIVE COATINGS FOR COLUMBIUM BASE ALLOYS. Lublin, P.; Sutkowski, W. J.; Rittershaus, E.; B[illegible], J. (General Telephone and Electronics Labs. Inc., Bayside, N. Y.). Met. Soc. Conf., 41: 1083-1105(1967).

From Symposium on Physical Metallurgy of Refractory Metals, French Lick, Ind. See CONF-651025-(Vol.2)).

A description of changes occurring in coatings for Nb and Nb alloys at high temperatures under oxidizing conditions is presented. It is not possible to predict the behavior of the more complex coating system from that of the chemically simpler ones; however, the identification of the oxides as intermetallic compounds formed suggests many additional fundamental diffusion and oxidation experiments which could elucidate the detailed mechanisms of protection and failure in the coatings. The design of oxidation-resistant coatings requires consideration of a number of physical processes. There are a host of properties which determine life under actual service conditions and in specific circumstances might lead to a different order of superiority. In many cases, however, the understanding of the coating requires identification of the phases or chemical species present as the first step. (J.R.D.)

48336 METALLIC COATING SYSTEMS FOR THE OXIDATION PROTECTION OF TANTALUM ABOVE 3500°F. Rausch, J. J.; Hill, V. L. (Illinois Inst. of Tech., Chicago). Met. Soc. Conf., 41: 1107-32(1967).

From Symposium on Physical Metallurgy of Refractory Metals, French Lick, Ind. See CONF-651025-(Vol.2)).

It has been shown that Hf–Ta and Ir–Hf–Ta alloys form the basis for the development of slowly oxidizing reservoir protective coating systems useful above 3500°F. The effectiveness of Hf–20Ta alloy for the protection of Ta–10W was demonstrated in torch tests run on clad specimens at temperatures between 3500 and 3950°F. The refractory oxide coating developed on the alloy had good thermal cycling characteristics. The hafnium alloy layer was shown to be an effective sink, limiting the transfer of interstitials to the substrate until nearly complete conversion of the alloy to oxide occurred. The use of minor alloying additions of Hf in conjunction with Ta has been shown to effectively decrease the oxidation rate of iridium due to volatile oxide formation. (auth)

48337 CORROSION OF REFRACTORY ALLOYS BY REFLUXING POTASSIUM. Scheuermann, C. M. (Lewis Research Center, Cleveland). Met. Soc. Conf., 41: 1133-50(1967).

From Symposium on Physical Metallurgy of Refractory Metals, French Lick, Ind. See CONF-651025-(Vol.2)).

The compatibility of 13 niobium- and tantalum-base alloys with refluxing potassium was determined in a series of capsule tests at 1800 to 2400°F and for times up to 4000 hours. It was found that the ungettered refractory metal alloys are more rapidly and drastically attacked by refluxing potassium than are the gettered alloys. The corrosion resistance of the test alloys grouped in order of decreasing corrosion resistance to refluxing potassium is (1) T-111, T-222, C-129, D-14, Cb-752, D-43, AS-55, B-66, and FS-85; (2) Cb–1Zr; and (3) B-33, SCb-291, and Ta–10W. The corrosion resistance of the alloys in the first group appears to be sufficient for consideration of their use as containment materials in advanced space-power systems. The second group is probably of marginal corrosion resistance. The third group is judged to be unsatisfactory for containment of refluxing potassium. A mechanism for the corrosion of niobium and niobium alloys by refluxing potassium has been proposed, consonant with the experimental results. The mechanism, involving a proposed potassium–niobium complex oxide intermediate, is described for both gettered and ungettered alloys (1) for the case in which only small amounts of oxygen are present initially and (2) for the case in which large amounts of oxygen are available because of environmental contamination. (auth)

48338 CORROSION STUDIES OF COLUMBIUM ALLOYS. De Mastry, J. A.; Koester, R. D.; Berry, W. E. (Battelle Memorial Inst., Columbus, Ohio). Met. Soc. Conf., 41: 1151-67 (1967).

From Symposium on Physical Metallurgy of Refractory Metals, French Lick, Ind. See CONF-651025-(Vol.2)).

Results are presented which indicate that niobium-base alloys have been developed which may eventually be useful as cladding and structural materials in nuclear superheaters. This usefulness appears to be restricted to reactors utilizing deoxygenated steam. Niobium alloys of optimum composition form an oxide film that is

stabilized by the formation of the oxides of the titanium, vanadium, and chromium alloy additions. This film protects the sound metal from rapid oxidation by slowing the diffusion of oxygen through it, and may reduce the volume ratio of oxide to metal to the point that the associated volume change is of less consequence. The superior oxidation resistance of the alloy in the cold-worked condition appears to be related to the plasticity of the oxide film. The fine-grained oxide on the cold-worked material probably possessed the strength and ductility to accommodate the strain produced as the result of the volume difference between the base metal and oxide. The heat-conduction properties of the niobium-base alloys with their metallic oxide film would not be expected to suffer extensively. (J.R.D.)

48339 ELEVATED TEMPERATURE CORROSION STUDIES OF REFRACTORY METAL ALLOYS IN CESIUM VAPOR AND LITHIUM. **De Mastry, J. A.; Griesenauer, N. M. (Battelle Memorial Inst., Columbus, Ohio). Met. Soc. Conf., 41: 1169-87(1967).**

From Symposium on Physical Metallurgy of Refractory Metals, French Lick, Ind. See CONF-651025-(Vol.2)).

Tungsten W–0.9Nb, W–15Mo and W–25Re should perform satisfactorily in static lithium for periods of up to 1000 hours at 1370°C. At 1650°C all of the tungsten based materials undergo surface dissolution and grain boundary penetration. All of the tungsten-base materials are compatible with cesium vapor up to 1700°C for 1000 hours. At 1870°C the surface dissolution will limit the usefulness of the tungsten-base materials. Tantalum-12 tungsten does not appear to be a satisfactory choice for an emitter material even at 1370°C. The Ta–12W alloy reacts unfavorably with interstitial impurities present in the lithium and cesium. In addition, carbides such as TaC and Ta_2C are readily formed. Unalloyed rhenium undergoes dissimilar metal attack in lithium during 1000 hours of exposure at 1370°C and 100 hours at 1650°C. Molybdenum is transferred from the TZM capsules to the rhenium where inter-alloying occurred. The same phenomenon is noted in cesium vapor or vacuum at 1700 and 1870°C after 1000 hours of exposure. Both TZM and Mo–50Re could be utilized in lithium up to 1650°C and in cesium up to 1870°C for 1000 hours. The usefulness of these alloys is limited by strength since long times at the higher temperatures results in extreme grain growth. (auth)

48340 OXIDATION AND DIFFUSION IN Cr–Ti–Si, COATED B-66 AND D-43 ALLOYS. **Cox, J. D. (General Electric Co., Evendale, Ohio); Kerr, J. R. Met. Soc. Conf., 41: 901-17(1967).**

From Symposium on Physical Metallurgy of Refractory Metals, French Lick, Ind. See CONF-651025-(Vol.2)).

Test conditions are described under which the initial oxidation rate at 2000 and 2500°F in air was found to be nearly twice as high for coated B-66 alloy as for coated D-43 alloy. Initial rates were determined to be logarithmic while second stage oxidation for both alloys at both test temperatures was linear. It was noted that as the pressure was reduced to 0.05 mm Hg the weight gains diminished to zero in the short test period used. Diffusion rates were found to be very similar at 2000 and 2500°F for the coated B-66 and D-43 alloys. It was found, however, that the nature of the diffusion differed and surface cracks thereby exposed layers of differing composition. This fact may help to explain the noted differences in oxidation rates. (auth)

48341 REACTION RATE OF Nb-1 ZIRCONIUM ALLOY WITH OXYGEN AT LOW PRESSURES. **Hogan, J. F.; Limoncelli, E. A.; Cleary, R. E. (Pratt and Whitney Aircraft-Canel, Middletown, Conn.). Met. Soc. Conf., 41: 885-99(1967).**

From Symposium on Physical Metallurgy of Refractory Metals, French Lick, Ind. See CONF-651025-(Vol.2)).

The reaction rate of Nb–1 Zr alloy with oxygen at 2000°F is pressure dependent over the range of 10^{-7} to 10^{-5} torr, and conforms to the equation: $\log R = 22.188 + 11.867 \log P + 2.174 (\log P)^2 + 0.1414 (\log P)^3$. The reaction rate deviates very little from being a linear function with pressure. This deviation is believed to be caused by the oxygen arrival rate at the physisorbed layer being greater than the chemisorption rate from the physisorbed layer. (auth)

48342 GUIDELINES FOR SELECTION OF MARINE MATERIALS. **Tuthill, A. H.; Schillmoller, C. M. Nav. Eng. J., 81: No. 2, 69-89(Apr. 1969).**

Users and designers of marine equipment have available a large backlog of published data and experience for the selection of economical materials that will give reliable and durable service. Charts and summaries of these data are presented that permit the designer to screen his initial materials selection in terms of general wasting away, pitting, crevice effects, fouling, velocity effects and cavitation, galvanic effects, selective attack, stress corrosion cracking, deep immersion, and cost. These principles were applied in the selection of materials for sea water heat exchange systems, propellers, stern tube bearings, marine hardware, fasteners, marine wire rope, buoys, and floating platforms. Materials considered are Ni–Cr–Mo alloys, Ti, 304, 316, and 400 steels, Ni–Cr alloys, Ni–Cu alloys, Ni, 70/30 Cu–Ni, 90/10 Cu–Cu–Ni, Cu, admiralty brass, Al brass, bronzes, Zn, Al, C steel, cast iron, austenitic Ni cast iron, etc. (Metals Abstr.)

48343 EXPLORATORY STUDY OF SILICIDE, ALUMINIDE, AND BORIDE COATINGS FOR NITRIDATION/OXIDATION PROTECTION OF CHROMIUM ALLOYS. **Stephens, Joseph R.; Klopp, William D. (Lewis Research Center, Cleveland). Trans. Met. Soc. AIME, 245: 1975-81(Sept. 1969).**

Chromium alloys were coated with silicon, aluminum, and boron by pack cementation. None of these simple coatings provided adequate nitridation/oxidation protection for a Cr–0.17% Y alloy substrate as shown by a substantial increase in the ductile-brittle transition temperature after air exposure for 100 hr at 2100°F. Iron-modified silicide coatings afforded good protection, holding the transition temperature of air-exposed specimens to 350° compared with 200°F for uncoated unexposed specimens and 800°F for uncoated exposed specimens. Additional attractive combinations of modifying elements included Fe–Mo, Fe–Mo–W, Fe–Mo–W–Ti, and V–Mo–W–Ti. (auth)

48344 CORROSION, COMPATIBILITY, AND PROTECTIVE COATINGS. **pp 47-92 of Properties of Refractory Metals. Wilkinson, Walter D. New York, Gordon and Breach Science Publishers Inc., 1969.**

It is noted that refractory metals are more affected by gases than are many other metals. The corrosive effects of gases are reviewed in discussions of corrosion during fabrication, oxidation behavior, oxygen reactions with Ta, refractory metal service temperature in air, corrosion control, protective coatings, and compatibility with other metals and materials. (J.R.D.)

48345 CORROSION RESISTANCE OF TITANIUM AND ITS ALLOYS IN PRIMARY WATER AND HOT BRINE ENVIRONMENTS. **Feige, N. G. (Titanium Metals Corp. of America, West Caldwell, N. J.). pp 815-27 of Nuclear Desalination. New York, American Elsevier Publishing Co., Inc., 1969.**

From Symposium on Nuclear Desalination, Madrid, Spain. See CONF-681108.

A critical area in a nuclear desalination plant is the interface between the primary water or steam in the nuclear system and the hot concentrated brine in the desalination plant. Titanium, because of its compatibility with both environments, has been considered in these heat exchangers to reduce the probability of tube failure. Corrosion studies have been made in both environments. In the nuclear system under primary water conditions titanium appeared to suffer no corrosion attack other than the build-up of an adherent oxide tarnish film. In the hot brine environment pitting corrosion or crevice corrosion at elevated temperatures limits a commercially pure alloy as heat-exchanger tubing to service below 250°F. A series of titanium base alloys suitable for service to 350°F were tested. The laboratory experimental techniques which were developed are reviewed. The information obtained from each test was related to the mechanism of corrosion attack. The available alloy additions, and their effects in modifying the rates of reaction, are reviewed. Field service experience with titanium is also reviewed. (auth)

Preparation and Fabrication

Refer also to abstracts 47466, 47657, 47670, 48332, 48336, 48392, 48428, 48431, 48521, and 48544.

48346 (EUR-4283) AN EXPERIMENTAL STUDY OF SOME QUENCHING TECHNIQUES AS APPLIED FOR CERTAIN FCC METALS AND ALLOYS. **Lang, E.; Canetoli, S. (European Atomic Energy Community, Petten (Netherlands). Joint Nuclear Research Center). Apr. 14, 1969. 36p. Dep. CFSTI (U. S. Sales Only).**

Quenching techniques as applied commonly for certain fcc metals and alloys have been investigated with respect to their quench speed, effective quench temperature and reproducibility. Quenches have been executed from different temperature regions into water, silicon oil, liquid nitrogen, aqueous solutions of $CaCl_2$ and NH_3, helium gas and air. The experiments revealed that the drop method provides the most reliable operation. Typical quenching rates are of the order of 4×10^4 °C/sec in water and 500°C/sec in liquid nitrogen. (auth)

48347 (GAMD-9367) REFABRICATION COSTS FOR HTGR FUEL ELEMENT COMPONENTS. **Stelling, H. E. (Gulf General Atomic, Inc., San Diego, Calif.). June 16, 1969. Contract AT(04-3)-167. 15p. Dep. CFSTI.**

In an earlier study on refabrication, preliminary designs, capital costs, and operating costs were developed for a refabrication plant suitable for servicing a 15,000-MW HTGR economy (about 500 kg of thorium plus uranium per operating day). Using the cost data developed in the earlier study, costs have been allocated to the following areas: sol-gel fabrication of ^{233}U pyrocarbon-coated particles; sol-gel fabrication of ^{233}U pyrocarbon- and silicon carbide-coated particles; assembly of ^{233}U–^{235}U fuel elements; storage and packaging of ^{233}U–^{235}U fuel elements; assembly of ^{235}U fuel elements; and storage and packaging of ^{235}U fuel elements. Two fixed charge rates (FCR) were used to determine annual costs. In addition to the FCR used for utility company financing in the earlier study, an annual FCR of 30.43% was employed to approximate chemical company financing. Costs do not include licensing, interest during construction, working capital, and owner-operator field expenses. It is estimated that the inclusion of these expenses will raise costs less than 10%. Costs are representative only for large HTGR refabrication plants. (auth)

48348 (ORNL–4420, pp 77-85) ZIRCONIUM METALLURGY. Weir, J. R. Jr.; Rittenhouse, P. L. (Oak Ridge National Lab., Tenn.).

Experimental fabrication of Zircaloy-4 tubing was completed and described in a topical report. Examination of the texture, texture development, and texture gradients in this tubing is in progress. Preliminary evaluation of these data indicates that all of the textures can be explained by consideration of the stresses acting in the different fabrication processes. As a result of the examination of experimentally fabricated tubing, the feasibility of texture control through control of the ratio between wall and diameter reductions during fabrication was demonstrated. The first direct evidence was obtained that the development of texture occurs progressively from the outer surface to the inner surface of the tubing as fabrication proceeds. The testing of Zr single crystals in a state of pure shear stress is beginning. These experiments will be used to determine the deformation systems acting in Zr at elevated temperatures. (auth)

48349 (ORNL–4420, pp 173-87) TUNGSTEN METALLURGY. Patriarca, P.; Schaffhauser, A. C. (Oak Ridge National Lab., Tenn.).

Studies on the effect of extrusion temperature on the microstructure of duplex-extruded W have shown that at extrusion temperatures of 1450°C and higher, wrought starting structures from the primary extrusion recrystallize during preheat. At extrusion temperatures as low as 1150°C, recrystallization of a wrought starting structure occurs due to the additional heat generated during deformation. The experimental tube reducer has been installed and checked. Results of studies of chemical vapor deposition (CVD), show that the optimum pressure for obtaining uniformly thick sheets of W–5% Re is between 50 and 75 torr. Additional experiments with HF additions to the H_2–WF_6 gas mixtures have shown that HF does not adversely affect the deposition efficiency or surface texture of W deposits. Further studies on the formation of gas bubbles in CVD materials have shown a correlation between the fraction of the melting point at which the metal is deposited and the occurrence of gas bubbles after annealing. It appears that the deposition temperature controls the supersaturation of vacancies in the deposited metal, thus controlling the nucleation of gas bubbles. Additional long-time creep-rupture data have been obtained for arc-cast W alloys and used to determine Larson–Miller master curves for time to 1% creep. (auth)

48350 (ORNL–4420, pp 198-210) JOINING RESEARCH ON NUCLEAR MATERIALS. Adamson, G. M. Jr.; Slaughter, G. M. (Oak Ridge National Lab., Tenn.).

Work on the effect of minor elements on the hot ductility of Inconel 600 is nearing completion. In addition to the effects of individual elements on zero-ductility temperature (ZDT), it was found that exposure of certain compositions to temperatures 25 to 35°C above ZDT influences their ability to recover ductility on cooling. Preliminary data indicate that ductilities of 8% or less can prevail to temperatures as low as 1200°C. Studies to determine the effect of selected quantities of minor elements on the propensity of Inconel 600 toward hot cracking have continued under subcontract at Rensselaer Polytechnic Institute. A standard factorial analysis has been conducted on the effects of S, P, Mn, Si, Ti, and Al on cross-sectional area, depth of penetration, and diameter of gas tungsten-arc spot welds in Inconel 600. The various elements exhibited different effects depending upon the criterion involved; for instance, Al drastically decreases penetration while having a much smaller effect on increasing the spot width. However, this type of analysis could not evaluate the effect of varying amounts, and the data are being reevaluated by linear regression analysis. The relationships between major elements and microstructure that control the contents of delta ferrite in stainless steel weld metal is being investigated. A study of the effect of minor elements on the mechanical properties of Incoloy 800 at intermediate temperatures is well under way. The mechanical effects have been correlated with microstructure, and electron microscopy studies are also under way. In the stainless steel program in support of the Fast Flux Test Facility (FFTF), shipment of most test specimens to Battelle Northwest Laboratories was completed. Defects in welds in Inconel 600 by electron-beam welding were purposely made. Studies of surface-connected defects by means of scanning electron microscopy has continued, and it has been documented that hot cracking in the liquid-solid region during welding of TZM leads to more extensive cold cracking upon cooling through the ductile-to-brittle transition temperature. (auth)

48351 (ORNL–4420, pp 211-21) DEVELOPMENT OF LMFBR TUBING FABRICATION. Adamson, G. M. Jr. (Oak Ridge National Lab., Tenn.).

Fabrication studies have been directed toward type 316 stainless steel since work on the development of fabrication techniques for Ti-modified type 304 stainless steel has been phased out. Small-diameter tubing, 0.250 in. in outside diameter × 0.016 in. in wall thickness, has been made with six levels of cold work, 5, 10, 20, 30, 40, and 50%. Investigation results on interpass annealing temperatures between 800 and 2050°C indicates that recrystallized material can be obtained and, depending upon the level of cold work, that grain sizes can be as large as ASTM 5 or 6 or as small as ASTM 12. The effect of B on the hot ductility of type 316 stainless steel was examined and compared with the results obtained for a typical Ni-base alloy, Inconel 600. For B contents between 5 and 200 ppM by weight at 900 to 1200°C, no beneficial effect of B on hot ductility was found. Hot-working temperature appears to be a more important factor than B content. (auth)

48352 (RFP–1380) RELIABLE AND REPRODUCIBLE TECHNIQUE FOR MACROSCOPIC ETCHING OF TYPES 304 STAINLESS STEELS. Capes, James F.; Snyder, James W.; Calabra, Arthur E. (Dow Chemical Co., Golden, Colo. Rocky Flats Div.). Aug. 29, 1969. Contract AT(29-1)-1106. 3p. Dep. CFSTI.

A reliable procedure is described for macroscopic etching of Types 304 and 304L stainless steel forgings. The method is rapid and 100% reproducible. The surface of the forging to be examined is mechanically ground through a sequence of decreasing grit-size on silicon-carbide papers, including 600 soft grit. Prior to grinding, the entire forging is masked with a spray lacquer so that after grinding only the surface in question will be attacked by the etchant. (auth)

48353 (UCRL-Trans–10354) TITANIUM WIRE FOR SUBLIMATION PUMPS TO BE USED IN AN ULTRAVACUUM. Biguenet, C.; Shroff, A. M.; Mathiez, Ph.; Borossay, J. Translated by Ralph L. McElroy for Univ. of California Lawrence Radiation Lab., Livermore, from Vide, 23: No. 133, 15-20(1968). 10p. Dep. CFSTI.

Sublimation of titanium wire in order to obtain a getter film is attended by the release of gases, among them hydrocarbons and a great quantity of argon. Hydrocarbons result from the wiredrawing of titanium, and argon comes from the metallurgic processing of the metal. In order to avoid this gas release, especially that of argon which appears every time the metal is sublimed, it is proposed that a tungsten wire coated with titanium obtained by vapor-plating (pyrolysis) be used. The optimum conditions for the deposition are given, as well as the analysis of gases released during the sublimation. Such wire may be used at pressure ranges as low as 10^{-11} or 10^{-12} torr. (auth)

48354 (WARD–3791-41) STAINLESS STEEL CLADDING DEVELOPMENT. Quarterly Progress Report for the Period Ending June 30, 1969. (Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div.). Aug. 1969. Contract AT(30-1)-3791. 38p. Dep. CFSTI.

Work Performed under United States–Euratom Fast Reactor Exchange Program.

Activities in a program to improve commercially available Type 316 stainless steel for use in LMFBR cladding are reported. Results of mechanical testing are summarized along with those on processing vacuum melted material. Installation of a TIG welding facility for clad weldability testing is reported. Micro-characterization of Type 316 was completed. Sensitization studies continued. (J.R.D.)

48355 PROCESS FOR THE PRODUCTION OF IVa AND Va METALS OF THE PERIODIC SYSTEM AND THEIR ALLOYS. (to Monte Amiata Societa Mineraria per Azioni). British Patent 1,161,151. Aug. 13, 1969. Filed Jan. 10, 1967.

The conventional processes for the production of Ti, Zr, Hf, V, Nb, and Ta give only a low grade of purity or else are only suitable for the production of small quantities of metal; they are

also non-continuous and rather expensive. The method described employs reduction of the halides with amalgams, uses a lower temperature, is more easily controlled, and is a continuous operation. A difficulty encountered hitherto with amalgam reduction is that further processing of the reaction products has proved unsatisfactory, but this has been largely overcome in the variant described. A chloride of the required metal is reduced with an alkali or alkaline earth metal amalgam. The reaction mixture is treated with one or more aqueous solutions which combine with the ions of the required metal to form water-soluble compounds, prior to separation of the amalgam, and removal of the mercury by distillation. This gives a separation from by-products. The aqueous solutions employed may comprise dilute HCl, H_2SO_4, or HF to which is added a complexing agent such as oxalic acid, tartaric acid, citric acid, salicylic acid, or sulphosalicylic acid, but preferably oxalic acid. For production of alloys mixed halides are used. Examples are described. (UK)

48356 METHOD OF PRODUCING PURIFIED REFRACTORY METAL AND ALLOY POWDERS. Tarr, C. O.; Owen, L. V. (to United States Atomic Energy Commission). U. S. Patent 3,466,203. Sept. 9, 1969.

Porosity-free welds are produced from refractory metal powders which have been purified by leaching in dilute solutions of a mineral acid followed by heat treatment at elevated temperatures in a hydrogen atmosphere containing water vapor. (AEC)

48357 METHOD FOR PRODUCING RADIATION-SHIELDING LEAD PLATES. Azuma, Masao (to Hitachi Ltd.). Japanese Patent 1969-12572. June 6, 1969. Filed Nov. 9, 1965.

A method is described for producing lead plates for use as shielding against gamma radiation. The advantages of using this material include improved cooling of the shield heated by the radiation, high strength of the shield, and simple construction. First a lead cylinder, lined both externally and internally with stainless steel, is produced. The cylinder is then pressed from outside, so as to be flattened to some extent. A corrugated plate is inserted into the flattened lead cylinder. The flattened cylinder with the corrugated plate in it is pressed by means of two parallel plates, placed on both sides of the cylinder, until space in the cylinder disappears. The corrugated plate is removed from the flattened lead cylinder, so that coolant water can flow through this narrow corrugated space to cool the shield. If the space is not necessary, the internal lining and also the corrugated plate are not used; the procedure is similar to that just described. (NSA of Japan)

48358 APPLICATION OF REDUCTION-DISTILLATION METHOD FOR PREPARING HIGH-PURITY RARE-EARTH ISOTOPE METALS. Kobisk, E. H.; Grisham, W. B. (Oak Ridge National Lab., Tenn.). Mater. Res. Bull., 4: 651-62(Sept. 1969).

Reduction-distillation techniques were developed to provide high-purity rare-earth metal isotopes in a chemical and physical form compatible with cold-rolling of ultrathin foils. The method involves high-temperature reduction of rare-earth oxides, using a suitable metal reductant, with simultaneous distillation of the product metal from the reaction matrix. Metal condensates at a purity level of 99.95% (500 ppM total impurity) can be obtained, and the ductility of rare-earth metals at this purity permits ultrathin foils (0.00005 to 0.00002-in. thickness) to be prepared. Collection efficiencies of between 75 and 92% achieved even when only 15 mg of the element (in oxide form) is processed by the reduction-distillation method, which makes it highly valuable and effective in obtaining most of the rare-earth isotopes in elemental form. Foils cold-rolled from these pure materials are applicable for use in precision nuclear cross-section measurements and in solid-state physics experiments. (auth)

48359 VACUUM MELTING AND INGOT CASTING OF URANIUM IN WILD-BARFIELD ELECTRIC RESISTANCE LABORATORY FURNACE. de Freitas, Clauer Trench; Cintra, Sebastiao Hermano Leite; Gentile, Erberto Francisco; Capocchi, Jose Deodoro Trani (Instituto de Energia Atomica, Sao Paulo, Brazil). Metalurgia (Sao Paulo), 24: 273-80(Apr. 1968). (In Portuguese).

Starting materials for melting and casting experiments were small pieces of U metal, obtained by reduction of UF_4 with Mg. Impurities were chemically removed, the material crushed, and fed into a graphite crucible the inner walls of which were covered with $MgZrO_3$ or spinel to prevent C pickup. A stopper at the top prevented overflow of molten metal. An orifice at the bottom allowed rapid evacuation into a graphite mold. The crucible was placed in a water-cooled furnace and heated to 1300 to 1460°C. By combined mechanical and diffusion pumping a vacuum of 0.20 to 0.09 micron Hg was created. Melting under high vacuum removes contaminants of high vapor pressure. Rapid current reduction causes sudden temperature drop and facilitates removal of gases soluble in molten metal, such as H_2. The ingot yield varied from a medium of 82.4% to a maximum of 90.4%. (tr-auth)

48360 INFLUENCE OF STRESS RELIEVING ON OPTIMUM QUALITY TUNGSTEN SHEET. Hegedus, A. K.; Fusco, R. S. (General Electric Co., Cleveland). Met. Soc. Conf., 41: 705-25(1967).

From Symposium on Physical Metallurgy of Refractory Metals, French Lick, Ind. See CONF-651025-(Vol.1)).

Results of an investigation of the interrelated effects of cold working and stress relieving of W sheet are presented. It was found that for optimum forming characteristics at 1000°F or hotter, stress-relieved tungsten sheet with 1% to 5% recrystallization is to be preferred. Recrystallization in excess of 5% can be considered detrimental to the fabricability and general integrity of tungsten sheet. Stress relieving of tungsten sheet serves to lessen the degree of anisotropy, thereby enhancing forming characteristics. Increased amounts of cold working depress the ductile-brittle transition temperature in the rolling (longitudinal) direction; this is true in the transverse direction only up to a certain amount of cold work, approximately 92% under the conditions of this study. The transverse direction in tungsten sheet is the most sensitive to degree of cold work and in response to heat treatment; thus, it has the greater influence on the ultimate acceptability of the sheet product. (auth)

48361 METALLURGIYA I METALLOVEDENIE CHISTYKH METALLOV. VYPUSK VII. (Metallurgy and Metallography of Pure Metals. Number 7). Emel'yanov, V. S. (ed.). Moscow, Atomizdat, 1968. 180p.

Methods used to prepare pure metals, such as beryllium, chromium, hafnium, molybdenum, niobium, tungsten, uranium, zirconium, their alloys and compounds, and to investigate their mechanical-physical properties are described. The theory of metal refining by means of transport reactions is discussed. Methods for estimating reaction rates during the thermal disassociation of volatile compounds and for regulating the precipitation of pure metals and carbon coatings and other compounds are included. The results of investigating the mechanical-physical properties of monocrystals of rhenium, tungsten, and zinc are given. Data on friable transformations in cast and extruded molybdenum; internal friction in zirconium and other metals; x-ray studies of their thin structures; and diffusion and thermodynamic characteristics are included. The corrosion of construction materials in lithium coolants and the thermodynamic properties of uranium and its alloys with zirconium are discussed. (tr-auth)

48362 NUCLEAR REACTOR FUEL ELEMENTS. D'Eye, Royston Walter Mastin; Shennan, John Vincent (to United Kingdom Atomic Energy Authority). U. S. Patent 3,463,702. Priority date June 22, 1966, Great Britain.

A nuclear reactor fuel element comprising particles of ceramic fissile material, each having a coating of nonfissile ceramic material, the particles being contained in an outer ceramic container and the particles being bonded together in a region about each of their points of contact in the container by an individual bridge of bonding material of high thermal conductivity, the interspaces between the particles being free of bonding material. (Offic. Gaz.)

48363 FABRICATION AND EVALUATION OF HAFNIUM-TANTALUM CLAD ROCKET NOZZLES. Van Thyne, R. J.; Hess, A. L.; Rausch, J. J. (Illinois Inst. of Tech., Chicago). Met. Soc. Conf., 41: 1191-1207(1967).

From Symposium on Physical Metallurgy of Refractory Metals, French Lick, Ind. See CONF-651025-(Vol.2)).

Previous work has shown that Hf–Ta alloys containing 15 to 35% tantalum exhibit oxidation resistance for at least short times to temperatures up to 4000°F. Accordingly, procedures were developed for fabrication of Hf–20Ta clad, Ta–10W nozzles with a tantalum interlayer. Multilayer assemblies were edge welded and roll clad at 2400°F. Nozzles were spun at 1900 to 2000°F in air. The cladding thickness was about 0.035 and 0.020 in. on the inside and outside, respectively. With the exception of surface checking, limited to about 0.010 in., the results were encouraging. Results of metallurgical investigations and rocket engine firing indicate considerable promise for this materials system. (auth)

48364 IMPROVED TUNGSTEN FORGINGS. Kotfila, R. J.; Evans, F. D. (Aerojet-General Corp., Sacramento, Calif.). Met. Soc. Conf., 41: 1229-52(1967).

From Symposium on Physical Metallurgy of Refractory Metals, French Lick, Ind. See CONF-651025-(Vol.2)).

Results of investigations concerning the applicability of four techniques involving ring rolling to produce large-diameter rocket nozzle throat inserts are reported. The techniques studied included ring rolling, ring rolling followed by shear pinning, back extrusion followed by ring rolling, and upset and bend followed by

ring rolling. The last method was found best and is recommended for production of nozzle inserts. (J.R.D.)

48365 POROUS TUNGSTEN ION EMITTER DEVELOPMENT BY LIQUID PHASE SINTERING. Graham, J. W. (Astro Met Associates, Inc., Cincinnati). Met. Soc. Conf., 41: 1303-20 (1967).

From Symposium on Physical Metallurgy of Refractory Metals, French Lick, Ind. See CONF-651025-(Vol.2)).

Liquid phase sintering of W–Cu–Ni ternary alloy powder compacts was shown to produce a spherical tungsten structure which could be converted to useful ion emitter structures by further processing steps. The grain size control of such structures was shown to be dependent upon composition and low temperature sintering conditions which were easily controllable without highly specialized facilities. Pore size uniformity and distribution were shown to be dependent upon the use of fine (< 4μ) particle copper and nickel powders, and milling procedures that ensured thorough blending to distribute the copper and nickel. HCl acid leaching was shown to remove greater than 99% of the initial copper–nickel content without specimen oxidation. A hot nitric acid treatment was found to be necessary after HCl leaching in order to eliminate finished ionizer thermal instability, which was believed to be caused by residual chlorine or nickel. High chemical purity and good specimen strength were attained by a vacuum vaporization and sintering cycle to a temperature of at least 2750°F for 4 hours. Porous tungsten structures were prepared which met or exceeded porosity, density and permeability characteristic goals. (auth)

48366 STRENGTHENING OF COLUMBIUM ALLOY Nb-752 BY DUPLEX-ANNEALING PROCESS. Bewley, J. G. (Union Carbide Corp., Kokomo, Ind.). Met. Soc. Conf., 41: 369-86 (1967).

From Symposium on Physical Metallurgy of Refractory Metals, French Lick, Ind. See CONF-651025-(Vol.1)).

The duplex-annealing treatment incorporates the precipitation strengthening mechanism to improve the useful strength of niobium alloys. It is shown that such treatments increase the room temperature and elevated temperature strength of niobium alloys without seriously detracting from the equally important properties of fabricability and weldability. The strengthening mechanisms of precipitation and dispersion hardening, solid solutioning strengthening and strain hardening may be combined to provide strength exceeding that of recrystallized Cb-752 alloy. As the metallurgical behavior of these and similar materials is further understood, undoubtedly additional increases will be realized in the strength and creep resistance of such alloys. (auth)

48367 SOLUTION STRENGTHENING IN REFRACTORY METAL ALLOYS. Rudman, P. S. (Battelle Memorial Inst., Columbus, Ohio). Met. Soc. Conf., 41: 351-68(1967).

From Symposium on Physical Metallurgy of Refractory Metals, French Lick, Ind. See CONF-651025-(Vol.1)).

Many previous reviewers of solid solution strengthening have concluded that there is an apparent correlation with the atomic size difference between the components. An analysis of data is presented to show that for the bcc refractory metal alloys, when a short-range order solution strengthening mechanism is taken into account the behavior of at least those systems studied (Mo–Ti, Mo–V, Nb–Ti) is well accounted for, and again the need for electronic contributions vanishes. While there is much room for improvement in the precision of separating the solution strengthening from the intrinsic alloy strength and the precision of short-range order determinations, it seems that improvement here would not change the qualitative or even much the quantitative division of solution strengthening into size difference and short-range order contributions. The greatest shortcoming of the conclusion that short-range order can play an important role in strengthening refractory metal alloys is that a method of predicting the degree of short-range order in an alloy has not been found. It appears that the development of a general theory for predicting the occurrence of ordering the alloys is an important next step in the solution strengthening problem in refractory metal alloys. (J.R.D.)

48368 ATMOSPHERIC CONTROL OF CARBON CONTENT IN ANNEALING MOLYBDENUM BASE ALLOYS. Perkins, R. A.; Coons, W. C.; Mitchell, W. C. (Lockheed Missiles and Space Co., Palo Alto, Calif.). Met. Soc. Conf., 41: 317-34(1967).

From Symposium on Physical Metallurgy of Refractory Metals, French Lick, Ind. See CONF-651025-(Vol.1)).

Molybdenum alloys can be solution annealed to control the morphology and distribution of carbides and to remove the directionality effects produced by extrusion, forging, or breakdown rolling. Improved properties at both high and low temperature can be obtained by the use of in-process solution anneals. The solubility of carbon in Nb–TZM–Mo is considerably greater than 0.018 to 0.022% at the eutectic temperature (4000°F). Solution annealing consists of heating to a temperature at which all carbon is in solution. Precipitation of carbides cannot be suppressed on cooling. With proper ratios of (Nb, Ti) : C, the solution-annealed alloy can be aged at high temperature to transform coarse Mo_2C into a fine dispersion of (Nb, Ti)C within the grains. Molybdenum alloys are susceptible to rapid decarburization on heating above 3200°F in inert atmospheres, hydrogen, or vacuum containing trace amounts of oxygen or water vapor. Carbon most likely is lost from the surface by oxidation to CO. The rate of decarburization may be controlled by the rate of diffusion of carbon to the surface, rate of dissolution of precipitated carbides, or the decarburizing potential of the gas at the surface. Decarburization is accompanied by intergranular oxidation, which has a deleterious effect on hot workability. Loss of carbon must be prevented to realize the beneficial effects of solution annealing. Decarburization can be blocked by heating in atmospheres balanced in $CH_4 : H_2$ or $CO : CO_2$ ratios to be neutral or slightly carburizing to the alloy. Additional data on Mo–C equilibria, diffusion kinetics, and thermodynamics of gas/metal systems are needed to use this approach effectively in solution annealing Mo-base alloys. (auth)

48369 DOUBLE CRUCIBLE SYSTEM FOR ONE-GRAM SCALE PLUTONIUM REDUCTIONS. Conner, W. V.; Baaso, D. L.; Proctor, S. G. (Dow Chemical Co., Golden, Colo.). Trans. Met. Soc. AIME, 245: 1983-6(Sept. 1969).

A double crucible system was developed for 1-g scale plutonium reductions. The equipment consists of an inner MgO crucible, an outer MgO crucible, and a stainless steel pressure vessel. The reduction charge is placed in the inner crucible and the annulas between the inner and outer crucibles is filled with a mixture of calcium and iodine. The exothermic reaction between the calcium and iodine in the annulas supplies the heat required for complete reaction of the reduction charge and good metal coalescence. Metal yields of 80 to 85% were obtained from 1-g scale reductions and yields as high as 97.5% were obtained from 0.5-g scale reductions. The system was used to reduce charges containing as little as 0.1 g of Pu resulting in metal yields up to 90%. (auth)

48370 SEPARATION OF TANTALUM AND COLUMBIUM BY LIQUID–LIQUID EXTRACTION. Hunter, Willard L. (Bureau of Mines, Albany, Oreg.). Trans. Met. Soc. AIME, 245: 1999-2007(Sept. 1969).

Four solvent extraction systems were studied to determine their efficiency for extraction and separation of tantalum and niobium. Aqueous feed solutions of varying HF–HCl concentrations and metal content were contacted with equal volumes of cyclohexanone, 3-methyl-2-butanone, and 2-pentanone and solutions of varying $HF–H_2SO_4$ concentrations were contacted with equal volumes of 2-pentanone. One multistage continuous test was made in a polyethylene pulse column using cyclohexanone as the organic phase. In each system studied, niobium and tantalum purities in excess of 95% with respect to each other were obtained in single-stage tests at low acidities in the feed solution. Separation factors ranging from 1700 to 2400 were obtained when using HF–HCl mixtures in the aqueous phase. Best results were obtained when a solution of $HF–H_2SO_4$ was used as the aqueous phase and 2-pentanone as the organic phase. A separation factor in excess of 6000 was obtained in one stage with aqueous solution concentrations of 2 N HF and 2 N H_2SO_4. When acid concentrations were increased to 5 N HF and 10 N H_2SO_4, 99.9% of the tantalum and 98.2% of the niobium initially present in the feed solution were transferred to the organic phase. The separation of niobium and tantalum obtainable by means of the solvent extraction systems was found to compare favorably with other systems, including the $HF–H_2SO_4$–methyl isobutyl ketone system currently used by most producers for the extraction and separation of these metals. (auth)

48371 CARBIDOTHERMIC PRODUCTION OF METALS OF THE IVa, Va, AND VIa GROUPS AND THEIR ALLOYS. Kieffer, R.; Lihl, F.; Effenberger, E. pp 619-32 of II Konferencja Metalurgii Proszkow, 20–23 IX. 1967. Czesc II. Stolarz, S.; Missol, W.; Zolkowski, W.; Kurzeja, J.; Cyunczyk, A. (eds.). Krakow, Zakladzie Graficznym Politechniki Slaskiej w Gliwicach, 1967. (In German).

From 2nd Conference on Powder Metallurgy, Krakow, Poland. See CONF-670988-(Vol.2).

The carbidothermic production of molybdenum, titanium, and vanadium and their alloys from their respective C–O systems is described with phase diagrams, descriptions of the reduction processes required, and tabulated data on the results obtained. The results showed that for the production of alloys and pure metals it is advantageous to use hydrogen reduction for decreasing the oxygen content and to use high vacuum sintering with the last reaction materials. Final purification by electron beam melting was found to be desirable. (L.C.L.)

48372 WELDING FOR NUCLEAR POWER. Nichols, R. W. (United Kingdom Atomic Energy Authority, Culcheth, Eng.). Weld. Metal Fabr., 37: 344-51(Sept. 1969).

Special welding requirements of the nuclear industry are discussed in terms of size, neutron radiation effects, and thermal and chemical environment effects. Specific problems considered are stress-relief cracking of pressure vessel steels and welding of stainless steel for pressure vessel liners; problems associated with steel components in concrete pressure vessels, including that of lamellar tearing; welding processes for heat exchangers including reference to orbital welding of return banks, friction welding, and tube to tube-plate welding; processes for welding zirconium pressure tubes and aluminum alloy calandria for the SGHW; and techniques for welding magnesium and zirconium alloy fuel elements and their end seals. (UK)

48373 JOINING TUNGSTEN AND MOLYBDENUM TO COPPER BY DIFFUSION WELDING. Ushakova, S. E. Avtomat. Svarka, No. 6, 73-4(1968). (In Russian).

In semiconductor devices silicon rectifiers are joined to the copper contact via a tungsten or molybdenum wafer by means of soldering with a tin-based soft solder which adversely affects the electrical parameters of the device and narrows the range of its operating temperatures. The replacement of such soldering by vacuum diffusion welding was experimentally investigated with the object of minimizing these effects. The following materials were used in the investigation: tungsten, thickness (δ) – 1.3 mm, diameter 20 to 25 mm; molybdenum, (δ) = 1.3 mm, diameter 20 to 25 mm; M1 copper, (δ) – 0.3 to 0.5 mm. The welding was carried out in an SDVU-6 machine. It was found that the direct vacuum diffusion welding of W and Mo to Cu in various regimes (including the optimal regime t = 950°C, τ = 90 min, p = 1.6 kg/mm^2, vacuum of 1.10^{-4} mm Hg) did not produce a strong joint and no diffusion layer between these materials was observed. To bypass this difficulty, in subsequent experiments prior to their welding to Cu the W and Mo wafers were galvanically coated with a 10 to 14 μ-thick layer of Ni, whereupon the mechanical strength of the specimens were higher than the mechanical strength of the soldered specimens. The optimal welding regime in this case proved to be: t = 900 to 950°C, p = 1.6 kg/mm^2, τ = 30 min, vacuum of 1×10^{-3} mm Hg. The electrical resistance of the wafers welded by this regime averaged 1.2×10^{-6} ohm compared with 1.6×10^{-6} for the conventional soldered wafers. It was thus established that the vacuum diffusion welding of W and Mo wafers to the Cu contact, in silicon rectifiers, compared with their soldering, makes it possible to reduce electrical resistance by 20 to 30%, to expand the range of operating temperatures of these devices, and to enhance the strength of the joints. (JPRS)

48374 FILLER WIRE FOR THE WELDING OF HEAT-RESISTANT ALLOYS. CLASS 49, NO. 207701. Shnyakin, N. S.; Pravdin, A. V.; Bogdanovskiy, S. P.; Bobkov, V. I.; Kardonov, B. A. Izobret. Prom. Obraztsy, Tovarnyye Znaki, No. 2, 161 (1968). (In Russian).

A description is presented of a filler wire for welding of heat-resistant alloys. Components include carbon, manganese, silicon, chromium, molybdenum, titanium, aluminum, tungsten, iron, cerium, and nickel. To decrease the possibility of hot-crack formation and to promote ductility and high-strength joints during the welding of nickel-base alloys, the filler wire composition is established as follows: 0.08% max. carbon, 0.6% max. manganese, 0.35% max. silicon, 14 to 16% chromium, 12 to 14% molybdenum, 1.3 to 1.6% titanium, 0.6 to 0.9% aluminum, 2 to 4% tungsten, 4% max. iron, 0.02% max. cerium, and the remainder, nickel. (JPRS)

48375 EXTRUSION OF NEW NICKEL-BASE AND REFRACTORY-METAL-BASE ALLOYS. Manegin, Yu. V.; Taranenko, G. I. Stal, No. 8, 723(1968). (In Russian).

A technology for extruding molybdenum-base and tungsten-base alloy sheets and nickel-base heat-resistant alloy rods has been developed. An experimental batch of molybdenum and tungsten-alloy (alloyed with titanium and zirconium) sheets was obtained. The possibility of obtaining EI617, EP109 and EP220 alloys bars by extrusion with subsequent rolling and double extrusion was investigated. To compensate for heat losses during intermediate operations, the bars are heated and transported in molten glass. Hot extrusion of heat-resistant alloys results in bars with a high-quality surface suitable for second extrusion without machining. (JPRS)

48376 DUAL-FILLER-METAL WELDING OF Ti-6Al-6V-2Sn AND 6061 ALUMINUM PLATES. Wu, K. C. (Northrop Norair, Hawthorne, Calif.). Weld. J. (N. Y.), 48: 359.s-68.s(Aug. 1969).

A dual-filler-metal welding process has been developed that offers great flexibility for improving the weld metal strength, yet maintaining joint integrity. Two filler metals having different compositions but compatible to the base metal are fed into the molten pool under a moving tungsten arc. The feed rates for the two filler metals can be set independently to vary the deposit composition. With the dual-filler metal method, the fusion zone composition can be alloyed to as high a strength as can be tolerated without cracking. For the thick weldments, the composition in the fusion zone can also be adjusted in each pass so that the mechanical properties can be uniform throughout the thickness. The development of the dual-filler-metal process and the mechanical properties of weldments in Ti-6Al-6V-2Sn and 6061-T6 aluminum alloy are summarized. By adding the Ti-6Al-4V filler metal to the pure titanium filler metal, the tensile yield strength of the fusion zone in Ti-6Al-6V-2Sn weldment was increased within the range from 85 to 132 ksi in an as-welded condition. A similar increase in tensile strength of the fusion zone was obtained in the welded-and-aged condition. By adding the 6061 alloy to the conventional 4043 filler metal for welding of 6061-T6 alloy plate, the tensile yield strength was increased from 17 to 35 ksi in as-welded condition and from 40 up to 47.5 ksi in the solution-treated-and-aged condition. The weld strength exceeded the base metal strength without weld cracking. The dual-filler metal process increases the joint efficiency in difficult-to-weld alloys and allows the designer to select a proper composition of the fusion zone to meet the design criteria. (G.M.C.)

48377 RHENIUM COATINGS ON REFRACTORY METALS. Korobkova, G. A.; Solomko, Yu. V.; Mikhaylov, S. K. pp 96-109 of New Materials in the Machinery Industry, Leningrad, Izdatel'stvo, 1967. (In Russian).

Results of a laboratory investigation of the technology of electrolytic deposition of single- and multilayer rhenium coatings onto niobium and molybdenum are presented. Experimental data are given on the structure and physical and mechanical properties of the deposited coatings and on the effect of high-temperature heat treatment on these properties. Data are also given on the effect of rhenium coatings on the room and high temperature mechanical and physical properties of the base metals (niobium and molybdenum). (JPRS)

48378 ELECTROCHEMICAL DEPOSITION OF RHENIUM-TUNGSTEN ALLOY. I. POSSIBILITY OF DEPOSITING RHENIUM-TUNGSTEN ALLOY FROM AUEOUS SOLUTIONS. Nikitina, A. A.; Sominskaya, Z. M.; Vagramyan, A. T. (Inst. of Rare Metal Industry, Moscow). (Elektrokhimiya, 4: No. 1, 82-5 (1968). (In Russian).

The possibility of electrodepositing rhenium-tungsten alloy from aqueous solutions of ammonium or potassium perrhenate and sodium tungstate with different additives was studied. It is shown that tungsten and rhenium are codeposited from aqueous solutions containing ammonium sulfate and certain organic substances as additives. The ammonium-citric acid electrolyte was investigated and conditions for the electrodeposition of rhenium-tungsten alloy were determined. The alloy contained tungsten in concentrations ranging from 0.5 to 10.0%. These alloys were deposited from electrolytes containing salts of heptavalent rhenium (7 to 70 g/l), hexavalent tungsten (2 to 32 g/l), ammonium sulfate (100 g/l) and citric acid (100 g/l) at cathodic current density of 100 A/dm^2 and electrolyte temperature ranging from 60 to 80°C. X-ray analysis of the deposit indicates that during the electrolysis an alloy is deposited which is a tungsten-rhenium solid solution. (JPRS)

48379 HEAT TREATMENT OF REFRACTORY METALS. pp 301-32 of Properties of Refractory Metals. Wilkinson, Walter D. New York, Gordon and Breach Science Publishers Inc., 1969.

Methods of heat treating refractory alloys are described. These materials are heat treated mainly to put them in the stress relieved condition, to purify them, or to homogenize them. (J.R.D.)

48380 SURFACE FINISHING BERYLLIUM WIRE. Goodman, Elliot (Value Engineering Co., Alexandria, Va.). Contract AF 33(615)5368. Sci. Advan. Mater. Process Eng. Proc., 12: P.8.1-9(1967).

From 12th National SAMPE Symposium on Advances in Structural Composites, Anaheim, Calif. See CONF-671084.

A process for removing the nickel coating from 0.005 inch beryllium wire and subsequently producing a smooth finish is described. The process utilizes chemical and electrochemical metal removal techniques in conjunction with ultrasonic energy. Details of processing and control equipment to utilize this process to rapidly and economically finish long, continuous lengths of beryllium wire are presented. (auth)

48381 APPLICATION OF NUCLEAR REACTORS TO THE ALUMINA AND ALUMINUM INDUSTRY. Halzl, J. (Thermo-Energy Design Bureau, Budapest); Sigmond, Gy.; Szabo, Z.;

Torma, M. pp 773-83 of Nuclear Desalination. New York, American Elsevier Publishing Co., Inc., 1969.

From Symposium on Nuclear Desalination, Madrid, Spain. See CONF-681108.

The potentialities of dual-purpose nuclear power plants in the alumina and aluminum industry are discussed. The general trend in the alumina industry is to build big plants leading to increasing heat demands in the form of steam. The high load factor resulting from continuous operation, presents favorable conditions for the application of nuclear reactors. Even larger reactors, with correspondingly lower specific investment costs, can be achieved if an aluminum smelter with a high power demand is situated next to the alumina plant and both plants are supplied by the nuclear power station. If nuclear energy proves to be competitive, this not only leads to a reduction of the production costs of alumina and aluminum but may also provide an incentive to process bauxite and alumina in the country where they are mined and produced, where previously they had been exported. The alumina manufacturing processes and their energy demands, the results of economy calculations both for the back-pressure power plant supplying heat and electricity for an alumina plant only, and for the power plant supplying both the alumina plant and the aluminum smelter are given. Nuclear energy supply variants were based on the pressurized-water reactor, but for big alumina plants and for the combined supply of the alumina plant and the aluminum smelter, the application of advanced gas-cooled reactors has also been investigated. In the framework of the investigations carried out both for the pressurized-water and the advanced gas-cooled reactors, the over-all costs of producing 1 ton of alumina in relation to the temperature at which alumina is recovered from bauxite have been determined. On the basis of these computations the optimal temperature level of the heat demand can be established. (J.C.W.)

Properties Evaluations

Refer also to abstracts 47370, 47437, 47706, 47709, 48354, 48360, 48361, 48366, 48367, 48379, 48483, 48520, 48995, 49564, 49572, and 49601.

48382 (AECL–3287) SHORT TERM MECHANICAL PROPERTIES OF OZHENNITE 0.5. Wright, M. G. (Atomic Energy of Canada Ltd., Pinawa (Manitoba). Whitesheli Nuclear Research Establishment). Apr. 1969. 31p. Dep. CFSTI (U. S. Sales Only). CAN $1.00.

Ozhennite 0.5, a zirconium-base alloy containing 0.2% tin and 0.1% each of iron, nickel, and niobium, is known to have improved corrosion resistance to steam up to 450°C compared with Zircaloy-2 and Zr-2½% Nb, and a better rate of hydriding in Hb-40 coolant than Zr-2½% Nb. Its use in high temperature organic cooled reactors and boiling water reactors with high steam qualities is therefore being considered. The short-term, out-reactor mechanical properties of materials obtained for an in-reactor test are reported. Ozhennite 0.5 pressure tubes and fuel cladding can be produced without difficulty. These have about 10% lower strength but a higher ductility than equivalent Zircaloy-2 tubes. Other properties of the two alloys are very similar. Effects of cold work and heat treatment are also discussed. (auth)

48383 (AI-AEC–12801) OPERATION OF THE SYSTEMS QUALITY SODIUM LOOP: INTERIM REPORT. Murbach, E. W.; Heath, N. W. (Atomics International, Canoga Park, Calif.). Aug. 20, 1969. Contract AT(04-3)-701. 17p. Dep. CFSTI.

The Systems Quality Sodium Loop has been operated more than 20,000 hr. Over 100 retorts, small supply tanks, and other devices have been loaded with sodium from the loop. The carbon content has been maintained at less than 10 ppM; the oxygen content was also maintained at less than 10 ppM, probably less than 5 ppM. The hot-trap developed a leak and has been removed. There are no carbon sources in the loop, so the carbon content of the sodium has not increased. It is planned to replace the hot-trap. Three electrochemical oxygen-meter electrodes have been operated in the loop. All three electrodes have been responsive to changes in oxygen level. (auth)

48384 (BNWL–1105) EFFECT OF STRAIN RATE ON MECHANICAL PROPERTIES OF AUSTENITIC STAINLESS STEELS. Hoagland, R. G. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Sept. 1969. Contract AT(45-1)-1830. 21p. Dep. CFSTI.

A literature survey of high strain rate effects on the mechanical properties of austenitic stainless steels applicable to fast reactor technology showed little information available. Two general tentative observations were that the flow stress of austenitic stainless steels is more strain rate sensitive above 1000°F than below, and that ductility parameters are reduced at low temperatures by increasing the strain rate while, at high temperature, the opposite might be true. (auth)

48385 (IS-T-304) THE EFFECT OF STRESS ON THE LOW-TEMPERATURE OXIDATION OF NIOBIUM. Weirick, Lawrence John (Ames Lab., Iowa). May 1969. Contract W-7405-eng-82. 240p. Dep. CFSTI.

Thesis.

A lateral compressive stress of about 94,000 psi was found to exist in a thin film of niobium pentoxide which had formed on niobium oxidized near 425°C in oxygen at atmospheric pressure for up to three hours. This compressive stress agreed very well with a known value of room-temperature compressive strength of niobium pentoxide of 117,000 psi. A compressive stress in an "effective" thin film of NbO_x was found to be about 125, 150, or 177 thousand psi if the thin film was composed of Nb_6O, Nb_5O, or Nb_4O, respectively, the reported formulas for NbO_x. The resulting tensile stress on the substrate surface due to the oxidation process was found to be small, around 10,000 psi. It was found that the formation of niobium suboxide needles or plates, NbO_z, formed during the oxidation of niobium in the temperature range of 425 to 440°C, was a function of initial specimen oxygen concentration, oxidation temperature, and applied tensile stress. It was further found that when the oxygen concentration at the substrate surface had reached an equilibrium level and the suboxide plates had formed, only a small tensile stress (less than 10,000 psi on low oxygen content niobium) was needed to form microcracks in a surface of the metal associated with these suboxide needles. Evidence was given to show that these microcracks upon further oxidation formed niobium pentoxide wedges into the metal which caused premature failure of niobium metal parts. (102 references). (auth)

48386 (N–69-31883) DYNAMIC STRAIN AGING IN CARBIDE STRENGTHENED MOLYBDENUM ALLOYS. Raffo, Peter L. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). July 1969. 19p. (NASA-TN-D–5355). CFSTI.

A study was made of the dynamic strain aging processes in carbide strengthened molybdenum alloys. Strengthening due to dynamic strain aging was observed in the temperature range 1500 to 2400°F. The strengthening is believed to arise from the pinning of mobile dislocations by metal-carbon pairs or clusters and/or carbide precipitates. This immobilization of the dislocations led to a high work-hardening rate and the observed strengthening. (STAR)

48387 (N–69-31977) MECHANICAL PROPERTIES OF ARC-MELTED TUNGSTEN–RHENIUM–HAFNIUM–CARBON ALLOYS. Klopp, William D.; Witzke, Walter R. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). July 1969. 38p. (NASA-TN-D–5348). CFSTI.

A study was conducted on the effects of 4 at. % rhenium on the mechanical properties of hafnium carbide strengthened tungsten-base alloys. The high temperature strengthening from HfC and improved low temperature bend ductility from the rhenium addition could be combined without detrimental interaction. Maximum strength alloys contained 0.3 to 0.4 mole % hafnium carbide. The highest tensile strength observed at 3500°F was 75.4 ksi in the solution annealed and aged condition, while the mean 4t bend transition temperature noted was 200°F for as-rolled sheet. (STAR)

48388 (ORNL–4420, pp 243-53) PHYSICAL AND MECHANICAL METALLURGY OF REFRACTORY ALLOYS. Patriarca, P. (Oak Ridge National Lab., Tenn.).

The diffusivity, solubility, and permeability of N in W between 1000 and 1800°C have been determined. The aging characteristics and the morphology of the precipitated phases in alloys in the Nb–Hf and Ta–Hf systems depend on the quenching rate and the composition of the alloys. The ductility of alloys exhibiting a uniform dispersion of the second phase is greater than that of alloys showing precipitation at the grain boundaries. The effect of heat treatment on the creep-rupture properties of SU-16 at 980°C has been determined. The stress-rupture properties of C-129Y at 980, 1095, and 1205°C are reported. Electric resistivity measurements of Ta to 2600°C were within 5% of the literature values. An electrical heating method to measure thermal conductivity is being developed. The evaluation of alloy 8H (Ti–20% Zr–15% Ge) as an acceptable filler metal for joining graphite has been ascertained. Shear tests of brazements indicate that the braze is equal to or stronger than base metal of a similar geometry. (auth)

48389 (ORNL–4420, pp 254-61) CLADDING MATERIALS FOR SPACE ISOTOPIC HEAT SOURCES. Patriarca, P.; Donnelly, R. G. (Oak Ridge National Lab., Tenn.).

Creep testing of Haynes alloy No. 25 for short times between

1000 and 1300°C and for long times between 600 and 900°C shows weldments to have the same strength as base metal. Weld failures were quite common at the lower temperatures. The effects of vacuum on the creep behavior of Haynes alloy No. 25 at 800°C are greatly diminished as the specimen thickness is increased from 0.030 to 0.060 in. At 900°C, the creep rate of a 0.030-in.-thick specimen in vacuum is much greater and the rupture life is much less than when tested in air. The initial rate of evaporation of Haynes alloy No. 25 is greater than the rate of Hastelloy N, but the two are comparable after 1000 hr. The transformation from disorder to order increases the hardness, tensile strength, and creep strength of alloys and shows no tendency to overage. The evaporation rate of binary alloys of Co, Ni, or Fe with Pt decreases with the Pt content. The evaporation process increases the Pt content at the alloy surface. Ordered alloys evaporate at a lower rate than disordered alloys. (auth)

48390 (ORNL-TM-2651) COMPARATIVE CREEP-RUPTURE PROPERTIES OF W-25 PERCENT Re CONSOLIDATED BY ARC MELTING AND POWDER METALLURGY TECHNIQUES. Stephenson, R. L. (Oak Ridge National Lab., Tenn.). Sept. 1969. Contract W-7405-eng-26. 15p. Dep. CFSTI.

The creep-rupture properties of W–25% Re materials consolidated by arc melting (AM) and powder metallurgy (PM) techniques have been compared at 1650 and 2200°C for rupture times up to 1000 hr. At comparable stresses, PM material has a shorter rupture life and a lower rupture ductility than AM material. On the basis of secondary creep rate, PM material is weaker than AM material at 1650°C but stronger at 2200°C. Optical and electron metallography showed that voids form at grain boundaries in both materials. In the PM material, grain boundaries appear to be immobile, and massive growth of voids initiates fracture with very little deformation. In the AM material, grain boundaries appear to be mobile, and fracture seems to be forestalled by their ability to move. The relative creep rates can be explained on the basis of void growth and grain size. (auth)

48391 (ORNL-tr-2218) DISSOCIATION PRESSURE OF BISMUTH IN THE SYSTEM: BISMUTH–THORIUM. Dahlke, Olaf; Gans, Wigbert; Knacke, Ottmar; Mueller, Franz. Translated by C. E. Schilling and R. G. Mansfield (Oak Ridge National Lab., Tenn.), from Z. Metallk., 60: 465-8(1969). 8p. Dep. CFSTI.

The dissociation pressure of bismuth in the system bismuth–thorium was determined between 600 and 1400°C using the Knudsen effusion method. Isothermal dissociation curves and x-ray diagrams corroborated the compounds $ThBi_2$ and Th_2Bi_4 which do not form solid solutions. For ThBi a narrow range of homogeneity between $ThBi_{1.08}$ and $ThBi_{0.9}$ is indicated. The supposed compound Th_2Bi was not found using measurements of the partial pressure. Values of $\log_{(PBi + PBi_2)\,[at]}$ are included for the vapor pressure and for the pressure of dissociation of bismuth in the univariant equilibria. (auth)

48392 (WARD-3791-34) VANADIUM ALLOY CLADDING DEVELOPMENT. Quarterly Progress Report for the Period Ending March 31, 1969. Bishop, E. C.; Nadler, R. A.; Whitlow, G. A. (Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div.). May 1969. Contract AT(30-1)-3791. 49p. Dep. CFSTI.

During the report period the nuclear and economic analysis of vanadium fuel element cladding was completed. All of the requested rod in the five alloys has been shipped to AEC contractors; most of the requested sheet has also been shipped. Tube drawing is proceeding; difficulties have been experienced with the drawing of the V–15Cr–5Ti alloy. Rupture life and secondary creep rate in the VANSTAR-7 alloy are markedly affected by purity of the test environment. Samples removed from the high velocity corrosion loop (14 fps) after 1500 hours operation all showed weight gains, which were, as anticipated, greater than the weight gains observed in the low velocity system (5 fps). High surface concentrations of interstitials have been confirmed in the 1500 hour corrosion samples. Little further deterioration in mechanical properties was observed in corrosion samples exposed to sodium for 2650 hours. Analysis of the stainless steel loop tubing found carbon and nitrogen depletion at the sodium exposed surface. At the air exposed surface, results indicated that nitrogen had diffused into and through the tubing. Calculations based on diffusion data have confirmed these results. In the WARD/PNL high flux irradiation program, a pin containing 48 vanadium alloy specimens, in addition to other PNL material, was inserted in Row 2 EBR-II. Two carbide fueled pins each containing a vanadium alloy tensile specimen, were also inserted in EBR-II. (auth)

48393 EXPERIMENTAL BURNING RATES AND COMBUSTION MECHANISMS OF SINGLE BERYLLIUM PARTICLES. Macek, Andrej; Semple, J. McKenzie (Atlantic Research Corp., Alexandria, Va.). pp 71-81 of Twelfth Symposium (International) on Combustion. Pittsburgh, The Combustion Institute, 1969.

Single spherical beryllium particles from two powder samples having average particle diameters of 32 and 25 μ, respectively, were injected into oxidizing gases, both moist and dry, at atmospheric pressure and at temperatures ranging from 2600 to 2960°K. The purpose was accurate measurement of metal burning rates and a study of parameters affecting these rates. Ignition efficiencies, burning rates, and flame diameters of particles were found to vary both with particle diameters and with ambient gas properties. It was concluded that beryllium particles may burn by several distinct modes. One is rapid vapor-phase diffusion flame, favored by high partial pressures of oxygen and high temperatures of the gaseous environment. The burning times corresponding to this mode, ranging from 1.3 to 4.5 msec, were found to be proportional to the square of the particle diameter and inversely proportional to a power of oxygen pressure slightly less than unity. As the partial pressure of oxygen was decreased below a certain value which was usually between 0.1 and 0.2 atm, the metal flame temperature decreased and vapor-phase combustion gradually changed over into slow surface reaction. There was also evidence of a third mode in which combustion was only moderately slower than the rapid vapor-phase burning. This mode, favored by low temperature and by the presence of water vapor in the environment, may be vapor-phase combustion hindered by a heavy coating of beryllia accumulated on the particle during the pre-ignition surface reaction. (auth)

48394 PRESSURE VARIATION OF THE ELASTIC CONSTANTS OF fcc INDIUM–THALLIUM ALLOYS. Hill, Edwin Roderick. Cleveland, Case Western Reserve Univ., 1968. 52p.

Thesis.

The pressure variation of the adiabatic elastic constants of four fcc indium–thallium alloys has been measured at 300°K using the ultrasonic pulse echo technique. The pressure derivative of the elastic constant C′ was negative and the derivative increased rapidly as thallium concentration was lowered toward the boundary that marks the transformation to the fcc phase. It has been confirmed that this shear constant vanishes in the vicinity of the phase boundary. An immediate consequence of the pressure study was that the phase boundary should move to higher thallium concentration as pressure is increased. Another consequence was that the temperature coefficient at constant volume of the constant C′ was negative and extremely large. It can also be predicted that the very low temperature thermal expansion coefficient of fcc alloys near the phase boundary should be negative, but this feature is probably not experimentally observable. The shear stiffnesses and their pressure derivatives were analyzed in terms of the Leigh model with plausible results. (Disser. Abstr.)

48395 SOME ASPECTS OF BERYLLIUM POWDER METALLURGY. Logerot, J.-M.; Syre, R. Metaux (Corros.-Ind.), 44: 169-86(May 1969). (In French).

Fritted beryllium is experiencing an increasing development in aerospace engineering where its physical and mechanical characteristics are put to the best use. For the most ambitious applications, as mechanical pieces of high precision, the standard commercial quality is not always adapted to the requirements of the user. This is why some researches have led to cooperation with the users to increase the mechanical properties and the engineering qualities of the material: by making use of powders of higher purity; by increasing the fineness of the powder without damaging its purity; by addition of certain metallic elements or of certain insoluble phases; and finally by the application of various thermal treatments adapted to the sphere of utilization and to the metallurgical history of the material. Thus it has been possible to obtain fritted pieces with a high elastic limit (50 to 60 hbar), sheets with improved texture, drawn bars with good weldability, but possessing nevertheless a deformation capacity of 30 to 50%, structures resistant to creep at high temperature, etc. (tr-auth)

48396 BRENNELEMENTE VON KERNREAKTOREN. (Nuclear Reactor Fuel Elements). Klusmann, Arno; Voelcker, Helmut. Thiemig-Taschenbuecher, Band 25. Munich, Verlag Karl Thiemig KG, 1969. 214p. DM 16,80.

Fuel element technology determines to a great extent the development of nuclear power plants. The physical, thermodynamic, and material engineering descriptions of fuel elements are presented for reactor types presently available. The questions of fuel supply, fuel processing, and fuel cost calculations are also considered. (tr-auth)

48397 DISLOCATION RELAXATION IN NIOBIUM AND NIOBIUM ALLOY SINGLE CRYSTALS. Amateau, Maurice Francis. Cleveland, Case Western Reserve Univ., 1968. 215p.

Thesis.

Internal friction measurements from 4 to 400°K were made to study the dislocation relaxation phenomena in unalloyed niobium and in Nb–Mo, Nb–V, and Nb–Zr alloys. Single crystals deformed in tension to various amounts and from 298 to 77°K were studied at the frequencies of 100 khz and 20 mhz using resonant bar and pulse echo techniques. Torsion pendulum studies were also conducted on wire specimens swaged from single crystals. Two relaxation peaks identified as the α and β-peaks which are characteristic of bcc transition metals were found in unalloyed zone refined niobium and in niobium alloys containing up to 17 atomic per cent solute. The response of these peaks to deformation indicated that they resulted from intrinsic dislocation processes similar to the Bordoni peak in fcc metals. The α-peak appeared to be due to double kink generation of edge dislocations, and the principle effect of substitutional and interstitial impurities on this peak was to lower its height and to shift the peak to lower temperature. The peak lowering was attributed to the reduction of total dislocation segment length which could undergo relaxation by solute pinning, while the peak temperature shift was due to an increase in the attempt frequency. Substitutional solute elements broadened both the α and β-peaks resulting in asymmetry on the high temperature side of the peak. This effect suggests that higher energy processes occur in the alloys. No simple-correlations existed between individual solute atom properties and the dislocation relaxation peak behavior. (Disser. Abstr.)

48398 WETTING OF METAL SURFACES BY LIQUID ALKALI METALS. Barlow, Malcolm; Planting, Peter John (Stanford Research Inst., Menlo Park, Calif.). Z. Metallk., 60: 719-22 (Sept. 1969).

The wetting of different metal surfaces by liquid sodium, potassium, and cesium metals has been studied. It is shown that a reliable way of ensuring wetting of transition metal surfaces is to thoroughly clean the surface by an argon ion-bombardment procedure. By this method, wetting has been observed with certain metal couples that have previously been reported to be nonwetting systems. Examples of such systems include Cu–Na, Ni–Na, and Cu–K. Mechanisms of wetting by liquid alkali metals are discussed. (auth)

48399 ISSLEDOVANIYA V OBLASTI ELEKTROOSAZHDENIYA METALLOV. MATERIALY X RESPUBLIKANSKOI KONFERENTSII ELEKTROKHIMIKOV LITOVSKOI SSR, 12–13 DEKABRYA 1968 G. (Studies of Electroprecipitation of Metals. Reports of the Tenth Conference of Electrochemists in Lithuanian SSR, December 12–13, 1968). Matulis, Yu. Yu. (ed.). [Vilnyus, USSR, Institute of Chemistry and Chemical Technology, 1968]. 184p. (CONF-681217).

Fifty-three reports are included on electrolytic deposition of metals, alloys, and combined coatings. Electrolysis of Ni, Co, W, Zn, Cu and other metals is discussed. Chemical precipitation of magnetic alloys of Co–P–Mo, Co–W, Ni–Cr, Mn–Cr, the physical and chemical properties of galvanized metals, and the effects of glance additives are included. (R.V.J.)

48400 THERMAL ACTIVATION IN ZIRCONIUM–CARBON ALLOYS. Das Gupta, P.; Arunachalam, V. S. (Bhabha Atomic Research Centre, Bombay). Trans. Indian Inst. Metals, 21: No. 4, 29-33(Dec. 4, 1968).

The effect of temperature and strain-rate on the yield and flow of zirconium containing about 1.4 at. % carbon has been examined at different temperatures between 77 and 700°K. The results of these measurements showed that in pure iodide zirconium, the thermal component of flow stress and its activation energy are increased with the addition of carbon. This effect is strongly felt only during the first stage of thermal activation where impurities are rate-controlling. However, for impure zirconium, addition of carbon does not alter the activation parameters associated with the thermally activated deformation significantly. This is discussed on the basis of the potency of carbon as a hardener compared with oxygen. (auth)

48401 YIELD BEHAVIOR OF NIOBIUM SINGLE CRYSTALS. Huffaker, D. C.; Sinclair, G. M. (Univ. of Illinois, Urbana). Met. Soc. Conf., 41: 3-23(1967).

From Symposium on Physical Metallurgy of Refractory Metals, French Lick, Ind. See CONF-651025-(Vol.1)).

The effect of temperature, strain rate, and microstructure on the yield behavior of niobium single crystals with ⟨110⟩ direction parallel to the compression axis has been examined. From room-temperature yield-strength measurements on 38 specimens, a statistical analysis showed that the variation in the yield strengths among the specimens tested at the same strain rate could be approximated by a normal distribution. The coefficient of variation for the yield strength in the highly uniform specimens was 5.9 percent. Because the yield strength of individual specimens was independent of the location along the rod from which they were taken, it is concluded that for the material investigated, this variation was due to random scatter. (auth)

48402 WORK-HARDENING IN TANTALUM SINGLE CRYSTALS. Mitchell, T. E.; Spitzig, W. A. (Case Inst. of Tech., Cleveland). Met. Soc. Conf., 41: 25-45(1967).

From Symposium on Physical Metallurgy of Refractory Metals, French Lick, Ind. See CONF-651025-(Vol.1)).

Results in a program to elucidate the nature of work hardening in bcc metals are described. The results are concerned mostly with transmission electron microscopy of Ta single crystals deformed in tension. Discussions of dislocation substructures observed in relation to work hardening in bcc metals are included. (J.R.D.)

48403 TEMPERATURE AND STRAIN RATE DEPENDENCE OF MICROYIELD POINTS IN TANTALUM. Kossowsky, R. (Curtiss-Wright Corp., Woodridge, N. J.). Met. Soc. Conf., 41: 47-68(1967).

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An annealed specimen of Ta did not exhibit an elastic limit upon the first test, where the elastic and anelastic limit actually coincide. After dropping from its initial value, σ_E was independent on further prestrain, up to 6% (maximum test range), but increased with decreasing temperature, from 7500 psi at 398°K, to 15,000 psi at 77°K. σ_E was further found to be independent on strain rate between the limits 2×10^{-4} sec^{-1} to 2×10^{-2} sec^{-1}. The anelastic limit was independent on prestrain up to 5×10^{-3} strain. The temperature dependence of σ_A was stronger than that of σ_E increasing from 14,000 psi at 298°K to 48,000 psi at 78°K. Necking occurs immediately after the macroscopic yield point below 175°K, for this reason straining at low temperatures was limited to strains below 5×10^{-4} to maintain true-stress true-strain condition. Upon continuous loading and unloading higher stress was necessary to obtain an open loop. Thus, a sharp work hardening occurs at the early stages of the microyield region. The stress difference between the initial and final values of σ_A increased with decreasing temperature. Strain rate cycling tests had shown that σ_A was independent of strain rate. Activation volumes (V*) and activation energies (H), calculated from the strain rate and temperature dependence of stress (above σ_A) were found to decrease with increasing strain up to $\epsilon_p = 5 \times 10^{-4}$, where V* and H were in agreement with published data on tantalum. Rate of work hardening in the microstrain region increased with increasing strain rate and decreasing temperature. A parabolic relationship was observed between stress and strain up to ϵ_p 5×10^{-5}. This relationship could be explained by the Brown–Luckens model, where the density of operative sources at room temperature was on the order of 1 in 10 grains, for grain size of 40μ. (auth)

48404 PETCH ANALYSIS OF HYDROGENATED TANTALUM SHEET. Gazza, G. E. (Army Materials Research Agency, Watertown, Mass.). Met. Soc. Conf., 41: 69-79(1967).

From Symposium on Physical Metallurgy of Refractory Metals, French Lick, Ind. See CONF-651025-(Vol.1)).

Anomalous mechanical behavior of hydrogenated tantalum specimens was investigated at 78 to 298°K. The Petch equation, $\sigma Ly = \sigma_i + k_yd^{-1/2}$, was used, where σLy is the lower yield stress and Zd is the grain diameter. σi and k_y are material constants commonly identified with lattice friction stress and dislocation locking stress respectively. Results of investigation are tabulated and discussed. (J.R.D.)

48405 CRACK PROPAGATION IN SINGLE CRYSTALS OF MOLYBDENUM. Beardmore, P.; Hull, D. (Univ. of Liverpool). Met. Soc. Conf., 41: 81-94(1967).

From Symposium on Physical Metallurgy of Refractory Metals, French Lick, Ind. See CONF-651025-(Vol.1)).

A series of experiments involving hydrogen-induced cracking of single-crystal Mo is described. The results are compared with those obtained in similar experiments using monocrystalline W. The outstanding difference between the effect of temperature on crack propagation in molybdenum and in tungsten single crystals is in the appearance of the fracture surface. In tungsten, the clear spike along [100] becomes more restricted as the temperature of deformation is raised but is still present even on the fracture faces of specimens in which the initial crack propagation occurred by slow growth. In molybdenum crystals, the clear spike which is very clearly defined in the high stress fractures at 77°K decreases in clarity as the temperature is raised, and eventually is replaced by a "fan" shaped region. In addition, the deformation associated with crack propagation as evidenced by river lines is quite different in the two metals. In tungsten, the cleavage markings were similar at all the testing temperatures. The cleavage markings in

molybdenum change from a type similar to those in tungsten in the high stress fractures at 77°K to a much finer, high density distribution of river lines without evidence of twin formation. The results, together with those for tungsten, emphasize that brittle fracture, i.e., fracture before yielding, does not occur in pure body-centered cubic metal single crystals in the absence of pre-existing flaws. In addition, the deformation modes in single crystals of both molybdenum and tungsten do not nucleate cracks prior to the onset of necking and, therefore, cleavage fracture during the uniform strain portion of the stress-strain curve of these metals is atypical. (J.R.D.)

48406 FRACTURE INITIATION AND PROPAGATION IN POLYCRYSTALLINE MOLYBDENUM. Wilcox, B. A.; Gilbert, A. (Battelle Memorial Inst., Columbus, Ohio). Met. Soc. Conf., 41: 95-115(1967).

From Symposium on Physical Metallurgy of Refractory Metals, French Lick, Ind. See CONF-651025-(Vol.1)).

A review of past investigations revealed that two distinct mechanisms of crack nucleation occur in polycrystalline molybdenum: twin-induced cleavage and grain-boundary cracking in compression tests, and slip-induced grain-boundary fracture in tension and bend tests—often facilitated by the presence of Mo_2C precipitates in the boundary. Evidence has been found which suggests that Cottrell-cleavage cracks may nucleate in molybdenum single crystals tested at low temperatures. A modified version of the Robertson crack-stop test was employed to provide useful information regarding crack propagation in both wrought and recrystallized molybdenum sheet. The limiting temperature for the penetration of a brittle crack was found to be ≈210°C for wrought material and >400°C for recrystallized material. It is concluded that the ductile brittle transition temperature determined by tension (or bending) tests, usually about −50 to 0°C, reflects a "crack-initiation transition temperature"; whereas this temperature in molybdenum, measured by tests such as V-notch impact, probably reflects a "crack-propagation transition temperature." (auth)

48407 EFFECT OF GRAIN SIZE ON THE YIELDING AND FLOW OF MOLYBDENUM. Orava, R. N. (Franklin Inst. Research Labs., Philadelphia). Met. Soc. Conf., 41: 117-40 (1967).

From Symposium on Physical Metallurgy of Refractory Metals, French Lick, Ind. See CONF-651025-(Vol.1)).

The dependence on grain size of the low temperature macroscopic flow stress of arc-cast molybdenum was investigated as a function of strain, temperature, and strain rate. For the ranges examined, the upper and lower yield stress, and uniform flow stress obey a general equation of the form $\sigma = \sigma_0 + kl^{-\frac{1}{2}}$ for specimens with a grain diameter, l, less than 0.25 mm. Above 0.25 mm this relation is no longer satisfied so that σ_0 cannot be identified with the flow stress of a single crystal taken at the equivalent position on the stress-strain curve. The grainsize dependence of the upper and lower yield stress below 0.25 mm is attributed to the variation with grain size of three quantities: the effective strain rate; the initial mobile dislocation density; and grain boundary resistance. Only the third contributes to the grain-size dependence of the flow stress. No mechanistic meaning can be ascribed to σ_0 but the lattice friction stress can be equated to the single crystal flow stress at the pertinent value of strain. The contradictory observations of the temperature dependence of the k_y values for several bcc transition metals can be resolved on the basis of the variation with grain size of the parameters associated with the dislocation dynamics model of yielding. (auth)

48408 DEFORMATION STRUCTURE IN ZONE-MELTED MOLYBDENUM ABOVE ROOM TEMPERATURE. Lawley, A. (Franklin Inst. Research Labs., Philadelphia). Met. Soc. Conf., 41: 141-60(1967).

From Symposium on Physical Metallurgy of Refractory Metals, French Lick, Ind. See CONF-651025-(Vol.1)).

Results of an investigation of the stress-strain behavior of single-crystal molybdenum at 4.2 to 578°K are presented. It was found that at 578°K, the tensile work-hardening rate ($d\sigma/de$) of single crystal molybdenum oriented for single slip is ~50 kg mm^{-2}, and is independent of strain for $\epsilon \leq 0.056$. In the range 4 to 300°K, the work-hardening rate is higher and is a sensitive function of strain. Values of ($d\sigma/de$) > 2000 kg mm^{-2} are observed at 4.2°K for strains $\epsilon \sim 0.005$. The macroscopic yield stress is still temperature dependent above 300°K, and decreases from ~23 kg mm^{-2} at 300°K to ~3.5 kg mm^{-2} at 600°K. In the range 4.2 to 300°K, the slip band structure is characterized by the presence of long primary screw dislocations of Burgers vector ± a/2 [1$\bar{1}$1]. At 578°K, a high density of prismatic loops is observed elongated along ± [2$\bar{1}$1]; few long segments of primary screw dislocations exist but serrated angular and cusp-shaped segments of short length remain. The debris of dislocation loops has the same Burgers vector as the primary screw dislocations. Dislocation tangling is restricted to the immediate vicinity of inclusions or pinned grown-in dislocations. Secondary slip occurs by the operation of each or all of the vectors ± a/2 [11$\bar{1}$], ± a/2 [111], ± a/2 [$\bar{1}$11]. Jog formation is most likely the result of thermally activated cross-slip. However, it is possible that the magnitude of the dislocation uncertainty perpendicular to the slip plane in molybdenum at 578°K is sufficient to provide jog heights consistent with the width of the observed prismatic loops. The work-hardening level is controlled by the extent of secondary slip and by the recovery occurring through cross-slip. (auth)

48409 TENSILE DUCTILITY-TRANSITION IN MOLYBDENUM. Lement, B. S.; Kreder, K. (ManLabs, Inc., Cambridge, Mass.). Met. Soc. Conf., 41: 161-83(1967).

From Symposium on Physical Metallurgy of Refractory Metals, French Lick, Ind. See CONF-651025-(Vol.1)).

As determined by tensile tests on molybdenum of relatively low interstitial content, the ductility-transition temperature (T_d) and the brittleness-transition temperature (T_b) corresponding to a fine grain size approximately coincide. With increase in grain size, T_b is lowered whereas T_d is raised corresponding respectively to changes in the relations of the yield (σ_y) and necking (σ_n) stresses to the observed fracture stress (σ_F). The occurrence of a minimum in σ_F at T_d is associated with the intersection of σ_F and the fracture stress corresponding to uniform fracture strain, i.e., necking occurs above T_d but not below T_d. For a fine grain size, σ_y also intersects at the minimum in σ_F. For the range of grain size studied (0.026 to 0.174 mm), the mode of fracture initiation is intergranular at or below T_d and is cleavage above T_d. At test temperatures below T_b, fracture occurs after a relatively small amount of plastic strain and is apparently controlled by crack initiation. Even though the amount of plastic strain prior to fracture increases markedly at test temperatures above T_b, crack initiation also appears to be the controlling step since no evidence of microcracks was found over the entire test temperature range. Above T_d, the effective surface energy (γ_i') for crack initiation was found to be about 0.35×10^4 ergs/cm^2 based on the Cottrell fracture relation as modified by using the flow locking parameter (k_f) instead of the yield locking parameter (k_y). The ratio of the flow locking parameter (k_f) to the yield locking parameter (k_y) is about 0.85 at room temperature and decreases to about 0.4 at −50°C. A minimum in k_f was found to occur at about −15°C which is between T_d and the temperature (T_m) that corresponds to a maximum in σ_F. Based on the Cottrell relation for crack initiation, the increase in σ_F from T_d to T_m is associated with decreases in both k_f and the effective grain size. The maximum in σ_F at T_m is associated with the subsequent increase in k_f after passing through a minimum value at about −15°C. (auth)

48410 MICROSTRAIN CHARACTERISTICS OF SINGLE CRYSTALLINE TUNGSTEN AND ITS ALLOYS. Galyon, George T.; Stark, Philip (General Precision, Inc., Little Falls, N. J.). Met. Soc. Conf., 41: 185-201(1967).

From Symposium on Physical Metallurgy of Refractory Metals, French Lick, Ind. See CONF-651025-(Vol.1)).

Results of investigations of microstrain tensile properties of electron beam-melted ⟨110⟩ crystals of tungsten and tungsten-tantalum are summarized. An increase in carbon content from 16 to 32 ppM increases the room temperature microyield strength of as-grown tungsten from 11,000 to 14,500 psi. The observed strengthening is attributed to increased carbide formation at dislocation sites. The addition of ¼% tantalum to tungsten increases the microyield strength to 21,000 psi. No further increase is obtained by raising the tantalum content to 3%. Solid solution hardening and subgrain refinement are believed responsible for the increase in microyield strength. The strain dependence of the microyield strength also is greater for the tungsten–tantalum alloys than for the pure tungsten crystals. For all crystals, three regimes of stress-strain behavior are noted. In region I, the early stages of plastic deformation, no difference is detected between the applied stress needed to produce a given strain and the subsequent microyield strength for that prestrain. In region II, the microyield strength no longer is equal to the prior applied stress and its strain-dependence is less than that of the applied stress. In region III, the macroscopic flow region, both the applied stress and the microyield strength are independent of total prestrain. The transition from region I to region II occurs at a lower strain value for the tantalum alloys than for the pure tungsten. The microyield strength for slip in tungsten and tungsten–tantalum crystals increases linearly with decreasing test temperature. The influence of room temperature deformation on the temperature dependence of the microyield strength was determined only for the tungsten–3% tantalum alloy. It was found that prestraining this alloy increases the temperature dependence. In addition, room temperature deformation increases the tendency of the 3% tantalum alloy to twin at low temperatures. Values of the elastic limit for pre-

strained tungsten and tungsten–tantalum crystals lie between 2,000 and 3,000 psi. The carbon contents of these crystals were in the range 16 to 18 ppM. Increasing the carbon content of the tungsten to 32 ppM raises the elastic limit to about 10,000 psi. The mechanism of catastrophic unpinning of dislocations proposed by Granato and Lücke to explain amplitude-dependent mechanical hysteresis appears to fit the behavior of tungsten crystals better than does the lattice frictional stress theory. (auth)

48411 ANNEALING BEHAVIOR OF ROLLED TUNGSTEN SINGLE CRYSTALS. Raymond, L. (Aerospace Corp., El Segundo, Calif.); Neumann, J. P. Met. Soc. Conf., 41: 203-14 (1967).

From Symposium on Physical Metallurgy of Refractory Metals, French Lick, Ind. See CONF-651025-(Vol.1)).

From the results of the hardness measurements, the x-ray photographs, and the dislocation etch pit studies of W, it can be seen that the amount, and the type of deformation, have a decisive influence on the annealing behavior. The dislocation structure introduced by a 10 per cent deformation, either by single or duplex slip proves to be very stable and temperatures above 2500°C are required for a complete recovery of the original single crystal properties. Between 1000 and 1400°C the annealing behavior of crystals deformed 50 per cent by either single, duplex or multiple slip is essentially the same. A small fraction of the hardness is recovered, the Laue streaks become somewhat sharper and the dislocation density decreases slightly, probably due to annihilation of dislocations of opposite signs. In agreement with these findings are the more sensitive measurements of the electrical resistivity and electron microscope studies. Above 1400°C the annealing behavior is different. For the same degree of deformation, the amount of stored energy increases with the complexity of the deformation mode in going from single to duplex and finally multiple slip. For duplex slip, recovery and recrystallization occur as two distinct processes such that the complete recovery of the hardness and dislocation density can be achieved without the onset of recrystallization. Subsequently heating the recovered crystal to temperatures where recrystallization had previously been observed resulted in a coalescence of the residual dislocation substructure into a few high angle boundaries. This effect can be contrasted to the large number of low angle tilt boundaries obtained on annealing these crystals at 2500°C after only 10 per cent deformation. In the case of deformation by multiple slip, the recrystallization temperature has been lowered to such an extent that recovery occurs simultaneously and no separation of the two processes is possible. (auth)

48412 ROOM TEMPERATURE TENSILE BEHAVIOR OF ⟨100⟩ ORIENTED TUNGSTEN SINGLE CRYSTALS WITH RHENIUM IN DILUTE SOLID SOLUTIONS. Garfinkle, M. (Lewis Research Center, Cleveland). Met. Soc. Conf., 41: 215-29(1967).

From Symposium on Physical Metallurgy of Refractory Metals, French Lick, Ind. See CONF-651025-(Vol.1).

The addition of rhenium to ⟨100⟩ oriented tungsten single crystals has a significant effect on deformation behavior. Rhenium additions both increased the proportional limit stress and decreased the flow stress of tungsten single crystals. While work hardening is appreciable in unalloyed tungsten, it is essentially nonexistent in the 9 at.% rhenium alloy until necking occurs. Discontinuous yielding occurs at 5 at.% rhenium, with the magnitude of the yield-point drop increasing with increasing rhenium content. The yielding and flow behavior of the 9 at.% rhenium ⟨110⟩ oriented crystals is similar to that exhibited by unalloyed ⟨110⟩ oriented tungsten single crystals but at a much lower stress level. Alloys with 5 at.% or more rhenium neck before failure; the cross section of the necked region is elliptical with axes in the ⟨110⟩ direction. This deformation process involves bending of crystallographic planes about the ⟨110⟩ axis. Similar behavior has been observed in the deformation of ⟨110⟩ oriented unalloyed tungsten crystals. While deformation of unalloyed crystals apparently involves slip on both {112} and {110} in the ⟨111⟩ direction, the addition of rhenium promoted {112}⟨111⟩ slip. Faint {110} slip traces were observed in the rhenium alloys only during necking. The 9 at.% rhenium alloy deformed uniformly only by {112}⟨111⟩ slip; {110} slip traces were observed only in the elliptical necked region. This observation suggests that work hardening in tungsten may be associated with {110} slip. (auth)

48413 RHENIUM DUCTILIZING EFFECT. Wukusick, C. S. (General Electric Nuclear Materials and Propulsion Operation, Evendale, Ohio). Met. Soc. Conf., 41: 231-45(1967).

From Symposium on Physical Metallurgy of Refractory Metals, French Lick, Ind. See CONF-651025-(Vol.1)).

It is postulated that solute segregation effects are in large part responsible for the Re-ductilizing effect in Cr, Mo, and W. The type of segregation which appears to best fit the properties of the alloys is solute clustering. The improvement in low-temperature ductility is thought to be caused by removal of interstitial elements from the matrix as a result of Re-induced clustering. (auth)

48414 EFFECTS OF INTERSTITIAL IMPURITIES ON TWINNING AND LOW-TEMPERATURE MECHANICAL PROPERTIES OF ELECTROREFINED VANADIUM. Keith, G. H.; Mathews, D. R. (Reno Metallurgy Research Center, Nev.). Met. Soc. Conf., 41: 247-64(1967).

From Symposium on Physical Metallurgy of Refractory Metals, French Lick, Ind. See CONF-651025-(Vol.1)).

Nitrogen and oxygen have substantially greater solubilities in vanadium than carbon and boron, and the amount of strengthening which can be achieved by addition of these elements appears to be primarily dependent upon the quantity of the elements in solid solution. Where low solubility exists, very little strengthening occurs. The occurrence of second-phase carbides and borides in the quantities and temperature range studied does not seriously affect ductility. The initial deformation mode changed from slip to twinning as temperature changed from 123 to 77°K. Oxygen or nitrogen in solution suppressed twinning in vanadium when in excess of a critical concentration; carbon or boron, precipitated as a second-phase, had little effect. High ductility was associated with profuse twinning, and conversely, when twinning was suppressed or inhibited the material became embrittled. (auth)

48415 TEXTURE DETERMINATION BY ANISOTROPIC PLASTIC BEHAVIOR EXHIBITED BY INDENTATIONS. Sandwith, Colin J. (Albany Metallurgy Research Center, Oreg.). Met. Soc. Conf., 41: 265-80(1967).

From Symposium on Physical Metallurgy of Refractory Metals, French Lick, Ind. See CONF-651025-(Vol.1)).

Sheet deformation textures in tungsten and molybdenum can be identified by the shape, orientation, and symmetry of indentation produced by indenters with a circular cross-section. Local surface distortions and slip line patterns of an indentation in tungsten single crystals tend to depict the rotational symmetry of the crystal axis which is parallel to the indenter axis. The symmetry of the plastic anisotropy of a simple sheet texture in tungsten and molybdenum is identical to that exhibited by a crystal with the ideal orientation of the sheet texture. Variations in simple sheet textures over short distances can be detected by variations in the symmetry, orientation, or shape of the indentation. The shape of a forging of a tungsten single crystal cylinder tends to exhibit the rotational symmetry of the crystal axis which was initially parallel to the external compressive forces. (auth)

48416 STRENGTHENING EFFECTS IN Ta–W–Hf ALLOYS. Ammon, R. L.; Harrod, D. L. (Westinghouse Astronuclear Lab., Pittsburgh). Met. Soc. Conf., 41: 423-42(1967).

From Symposium on Physical Metallurgy of Refractory Metals, French Lick, Ind. See CONF-651025-(Vol.1)).

Results of investigations are presented showing the effects of interstitial C or N solute additions on the high temperature strength of Ta–W–Hf alloys. The additions were made to the alloys T-111 and T-222. Data and discussions are included on mechanical properties, phase identification, and metallography. (J.R.D.)

48417 SOLID SOLUTION AND CARBIDE STRENGTHENED ARC-MELTED TUNGSTEN ALLOYS. Raffo, P. L.; Klopp, W. D. (Lewis Research Center, Cleveland). Met. Soc. Conf., 41: 501-18(1967).

From Symposium on Physical Metallurgy of Refractory Metals, French Lick, Ind. See CONF-651025-(Vol.1)).

The most effective solid solution strengthener in tungsten in the temperature range of 2500 to 4000°F is hafnium. Tantalum and niobium are less effective, while rhenium is the least effective. The same order holds in creep as in short time tensile tests. The relative solid solution strengthening effects could be correlated with the difference in atom size between tungsten and the solute atom. The strengths of ternary solid solution alloys could be represented as the sum of the individual strengthening effects found in the binary alloys at 2500 to 3500°F. Tungsten-tantalum-rhenium alloys showed greatly enhanced resistance to recrystallization at 3500°F. Carbon additions to W–Nb, W–Ta, W–Ta–Re and W–Hf alloys produced various degrees of strengthening. The greatest strengthening was found in the W–Hf–C system. The strongest alloy, W–0.20 percent Hf–0.26 percent C (0.017 wt percent carbon) had strengths of 88,200 and 62,500 psi at 3000 and 3500°F; respectively. The differences in strength between the various carbide strengthened alloys were related to the differences in carbide particle size. The particle size in the W–Hf–C alloys was the finest, being on the order of 0.05 to 0.20 μ. Carbon additions to unalloyed tungsten at 2500 to 4000°F produced a minimum in the strength-composition curve. This behavior may be caused by an increase in the self-diffusion rate of tungsten by carbon.

The nil-ductility temperature of arc melted tungsten was lowered by additions of carbon in the range 0.12 to 0.93 percent. (auth)

48418 THE EFFECT OF ALLOYING ADDITIONS ON LOW AND HIGH TEMPERATURE PROPERTIES OF A TUNGSTEN–MOLYBDENUM-BASE ALLOY. Foldes, Stephen (General Electric Co., Cleveland). Met. Soc. Conf., 41: 519-39(1967).

From Symposium on Physical Metallurgy of Refractory Metals, French Lick, Ind. See CONF-651025-(Vol.1)).

The rhenium alloying effect which has been postulated for favorable changes in electronic characteristics based on resonating covalent bonding theory does not extend to Group VIII metals Os and Ru. Gettering of interstitials, particularly oxygen by addition of reactive elements, as Ti, Zr, Hf, Cb and Ta causes a lowering in the ductile-brittle transition temperature (DBTT). This may be caused by removal of the interstitials from the matrix or the formation of second phase particles. The distribution or morphology of the dispersoids may also be important. The amount of alloying addition to achieve maximum benefit was dependent on the addition element. A W–Mo–1Ti alloy in the recrystallized condition, which had the lowest DBTT at 55°C (5% elongation), exhibited also plastic ductility (0.6%) at 24°C. Fracture initiation in the alloy systems under investigation was intergranular. At low temperature the fracture mode was grain boundary separation which changed to a mixture of intergranular rupture and transgranular cleavage as the threshold of ductility was reached. Ductile mechanical behavior was not associated with a shear type fracture mode. A phenomenological argument can be made for attributing the enhanced ductility on the fine oxide dispersion which preferentially outlined grain and subgrain boundaries. High temperature strength in W–Mo–0.3 Nb, W–Mo–5 Nb, and W–Mo–5Ta was 50% higher than that of W at 1649°C, only to diminish to the same levels as tungsten at 2206°C. However, the W–Mo–5Hf alloy maintained a 2:1 strength advantage over the entire range from 1649 to 2206°C. (auth)

48419 DUCTILITY AND STRENGTH OF DILUTE TUNGSTEN–RHENIUM ALLOYS. Klopp, W. D.; Witzke, W. R.; Raffo, P. L. (Lewis Research Center, Cleveland). Met. Soc. Conf., 41: 557-73(1967).

From Symposium on Physical Metallurgy of Refractory Metals, French Lick, Ind. See CONF-651025-(Vol.1)).

Results of an investigation indicate that sheet fabricated from electron-beam-melted (EB-melted) tungsten alloys containing 1.85 to 9.05 percent rhenium exhibit ductile-brittle bend transition temperatures in the worked condition as low as −75 to −100°F, compared with +200°F for unalloyed tungsten (electropolished). Sheet fabricated from similar arc-melted alloys was less ductile, with bend transition temperatures of 50 to 280°F. This difference suggests that the improved ductility may be related in part, to the higher purity achieved by EB melting. Important fabrication variables include cleanliness during rolling and rolling temperature. The best ductilities were obtained on sheet cleaned several times during rolling at temperatures of 1750 to 2400°F. Stress-relief annealing during or after rolling had little effect on ductility. Annealing at 3600°F significantly increased the ductile-brittle bend transition temperatures of both EB-melted and arc-melted alloys. Transition temperatures of about 400°F were observed for alloys containing 2 to 4 percent rhenium. High-rhenium alloys containing 24.0 and 25.6 percent rhenium had transition temperatures of 350 to 375°F after similar annealing treatments. Rhenium additions up to 9.05 percent strengthen tungsten at elevated temperatures in both short-time tensile and long-time creep. The alloys with 24.0 and 25.6 percent rhenium have similar tensile strengths to the 9.05 percent rhenium alloy, but in creep are considerably weaker, with strength approximating that of unalloyed tungsten. (auth)

48420 POWDER METALLURGY TUNGSTEN ALLOYS BASED ON CARBIDE DISPERSIONS. Friedman, S.; Dickinson, C. D. (General Telephone and Electronics Labs., Inc., Bayside, N. Y.). Met. Soc. Conf., 41: 575-95(1967).

From Symposium on Physical Metallurgy of Refractory Metals, French Lick, Ind. See CONF-651025-(Vol.1)).

Results of a program to develop wrought W-base powder metallurgy alloys with improved high temperature strength are reported. It was found that the Re effects can be additively combined with carbide dispersions presumably formed by solution and precipitation reactions to provide wrought W-base alloys having high elevated-temperature strength and ductility at or below room temperature. (J.R.D.)

48421 ARC MELTING, WORKING, AND PROPERTIES OF W–0.6Nb ALLOY. Inouye, S.; Saul, G. (Air Force Materials Lab., Wright-Patterson AFB, Ohio). Met. Soc. Conf., 41: 737-58(1967).

From Symposium on Physical Metallurgy of Refractory Metals, French Lick, Ind. See CONF-651025-(Vol.1)).

Results of an investigation are presented of small chemical additions on the properties of W-base niobium alloys. It was found that the arc-cast structure of tungsten +0.6% niobium is coarsened by decreasing melting power levels which reduce electrode melt rates. Titanium and oxygen additions have a net effect of coarsening the ingot structure at a given melting power level. However, lower melt rates are obtained and recovery of these elements in the ingot is low. Additions of carbon or zirconium refine the arc cast structure, raise the recrystallization temperature and enhance the 3000°F tensile properties of the base alloy. Although tensile data to determine the influence of carbon were not obtained, extrusion behavior indicated the potent strengthening effect of this element at extrusion temperatures of approximately 3800°F. The 3000°F tensile strength of the base alloy plus zirconium is dependent on the amount of cold work present or the grain size if recrystallized. This material in the fully recrystallized condition exhibits ultimate tensile strength about 4000 psi higher than the annealed base composition. (auth)

48422 ULTRAHIGH-VACUUM CREEP BEHAVIOR OF COLUMBIUM AND TANTALUM ALLOYS AT 2000° AND 2200°F FOR TIMES GREATER THAN 1000 HOURS. Titran, Robert H.; Hall, Robert W. (Lewis Research Center, Cleveland). Met. Soc. Conf., 41: 761-74(1967).

From Symposium on Physical Metallurgy of Refractory Metals, French Lick, Ind. See CONF-651025-(Vol.2)).

A screening study of the long-time, high-temperature (2000 and 2200°F) creep behavior of several commercially available, fabricable niobium- and tantalum-base alloys was conducted under conditions of ultrahigh-vacuum (10^{-8} to 10^{-9} torr). The results of long-time creep tests conducted on 0.030-in.-thick recrystallized fine-grained sheet specimens at common stress-to-density ratios of 2.6×10^4 and 1.3×10^4 in. at 2000 and 2200°F, respectively, indicate that the tantalum alloy T-222 has outstanding creep resistance under the test conditions investigated. For example, at 2000°F and a stress level of 15,900 psi (2.6×10^4 in.), T-222 exhibited only 0.10-percent total creep strain after 5000 hr of testing. The most creep-resistant niobium alloy, D-43, under the identical stress-to-density conditions at 2000°F exhibited 1.0 percent strain in 900 hr. At 2200°F and a stress level of 7900 psi (1.3×10^4 in.), T-222 exhibited 0.65-percent total creep strain in 5000 hr, while the strongest niobium alloy, D-43, tested at the identical temperature and stress-to-density ratio exhibited 1.0-percent strain in 750 hr. The relative order of creep strength at 2000 and 2200°F for the density compensated tests was the same and is as follows: T-222, Ta-10W, D-43, FS-85, T-111, and Cb-752. The creep properties of the materials evaluated and reported generally represent the properties of these materials tested in the fully recrystallized, fine-grained condition. It is likely that the creep resistance of many of the alloys could be improved by appropriate heat treatment or by optimizing the thermomechanical processing schedule. (auth)

48423 MECHANICAL PROPERTIES OF CERTAIN MOLYBDENUM, TUNGSTEN, AND TANTALUM SHEET ALLOYS. Gazza, G.; DeSisto, T. (Army Materials Research Agency, Watertown, Mass.). Met. Soc. Conf., 41: 775-88(1967).

From Symposium on Physical Metallurgy of Refractory Metals, French Lick, Ind. See CONF-651025-(Vol.2)).

Data are reported on results of chemical analysis, tensile properties tests at 75 to 3500°F, stress rupture tests at 2400 to 3500°F, and ductile-brittle transition measurements in bend tests of Mo-base alloys, Ta-base alloys and W-base alloys. (J.R.D.)

48424 THE CREEP AND STRESS-RUPTURE PROPERTIES OF TUNGSTEN SHEET BETWEEN 2500° AND 4000°F. Tavernelli, Joseph F. (General Electric Co., Cleveland). Met. Soc. Conf., 41: 807-22(1967).

From Symposium on Physical Metallurgy of Refractory Metals, French Lick, Ind. See CONF-651025-(Vol.2)).

The creep and stress-rupture properties of 0.060" GE-15 weldable tungsten sheet at temperatures between 2500 and 4000°F were determined. "As-produced" and recrystallized samples were used in this investigation. Both longitudinal and transverse directions of the sheet were evaluated for the "as-produced" material. The directional properties of the material were found to influence creep and stress-rupture properties at 2500°F but not at higher temperatures. The results when plotted as conventional creep and stress-rupture data were typical of other materials. Straight-line representation of the rupture properties with respect to the Larson-Miller parameter and its usefulness for design purposes is suggested. (auth)

48425 CREEP-RUPTURE PROPERTIES OF RHENIUM AND SOME ALLOYS OF RHENIUM AT ELEVATED TEMPERATURE. Flagella, P. N.; Tarr, C. O. (General Electric Co., Evendale, Ohio). Met. Soc. Conf., 41: 823-41(1967).

From Symposium on Physical Metallurgy of Refractory Metals, French Lick, Ind. See CONF-651025-(Vol.2)).

The stress-rupture and linear creep rate versus stress curves for unalloyed wrought sintered rhenium show a concave downward curvature when plotted on logarithmic coordinates. This may be related to the high rate of work-hardening required for rhenium. For the lower stresses at any temperature, the material is less creep-resistant than a linear extrapolation of the high stress (short time) data would indicate. At temperatures of 1600, 2200, 2600, and 2800°C, the short-time rupture life for rhenium is greater than that for arc-cast tungsten. In more prolonged tests, however, the rupture stress of tungsten is greater for identical time periods. Varying the fabrication processing method has a significant effect on the rupture life and the ductility at temperature for W–25Re, although no significant effect was observed on the linear creep rate. Above 1600°C, the larger the grain size, the more ductile the material. Arc-melted material gives the largest grain size and is more ductile as shown in tests at 2000°C. At 1600°C, the ductility is less for larger grain sizes. As with unalloyed rhenium, the W–25Re alloy developed stress-rupture and linear creep rate versus stress curves with a concave downward curvature on log–log parts. The addition of 50 weight percent rhenium to molybdenum increases the rupture life and creep resistance over unalloyed arc-cast molybdenum. The stress-rupture life and creep rate are linear with stress on a log–log plot over the stress range of 2000 to 6000 psi at 1600°C, and 750 to 1000 psi at 2200°C. (auth)

48426 MULTIMECHANISM BEHAVIOR IN THE CREEP OF TUNGSTEN. Gilbert, E. R.; Flinn, J. E.; Yaggee, F. L. (Argonne National Lab., Ill.). Met. Soc. Conf., 41: 861-82(1967).

From Symposium on Physical Metallurgy of Refractory Metals, French Lick, Ind. See CONF-651025-(Vol.2)).

Creep of tungsten in the temperature range of 0.3 T_m (800°C) to 0.8 T_m (2800°C) is controlled by at least three discrete mechanisms of deformation and possibly four. The rate controlling processes are connected by three regions of transition two of which are parallel type processes and the third is a sequential process. In each discrete region the steady-state creep rate can be expressed in terms of an activation energy, a stress function and a structure factor. Further experimental creep studies, theoretical analyses and diffusion experiments are necessary to determine all of the rate controlling mechanisms and the exact transitional behavior. More data on the stress and temperature effects on the second stage creep rate are needed. Accurate values for true stress and true strain rate data should be obtained in contrast to engineering values used in this analysis. Extensometers should be used to give accurate measurements of specimen strain. The effect on the creep rate of variables such as grain size and impurities should be determined over a wide range of temperature and stress. (auth)

48427 THE BEHAVIOR OF COMPOSITE Ag-INFILTRATED TUNGSTEN UP TO 5000°F. Dotson, C. L. (Southern Research Inst., Birmingham, Ala.); Kotfila, R. J. Met. Soc. Conf., 41: 1209-27(1967).

From Symposium on Physical Metallurgy of Refractory Metals, French Lick, Ind. See CONF-651025-(Vol.2)).

Results of investigations of 10% Ag–W composites are presented. Most of the data were obtained from tensile tests at 10 temperature levels between 70 and 5000°F. These data represent approximately 475 tensile tests using about 35 different billets of the Ag-infiltrated W. Data are included on compression, shear, and thermal properties. (J.R.D.)

48428 APPLICATION OF CAST TUNGSTEN TO ROCKET NOZZLES. Olcott, E. L. (Atlantic Research Corp., Alexandria, Va.); Elbaum, J. K. Met. Soc. Conf., 41: 1321-38(1967).

From Symposium on Physical Metallurgy of Refractory Metals, French Lick, Ind. See CONF-651025-(Vol.2)).

Results of the studies indicate that arc-cast tungsten possesses high resistance to cracking in rocket nozzle applications because of its capability to deform. Deformation is favored by large grain size and clean grain boundaries. Arc-cast tungsten shows relatively isotropic flow and fracture characteristics. After extrusion, the flow and fracture characteristics are also relatively isotropic as long as the material is completely cold-worked. This phenomenon is believed to be due to the fully recovered substructure of the extruded material. (auth)

48429 OPTICAL PROPERTIES OF MOLYBDENUM IN THE RANGE OF 2 TO 10 PHOTONS. Kapitsa, M. L.; Udoev, Yu. P.; Shirokikh, E. I. (Leningrad Polytechnic Inst.). Sov. Phys.-Solid State (Engl. Transl.), 11: 665-6(Sept. 1969).

Translated from Fiz. Tverd. Tela, 11: 814-16(Mar. 1969).

The reflection coefficient of a Mo single crystal was measured in the range 1.4 to 11 eV and compared with that for Ni. The components of the dielectric constant, ϵ_1 and $\epsilon_2(h\nu)^2$, were derived from the data for Mo and Ni and their implications for their band structures discussed. Energy loss functions were also derived and interpreted. (D.L.C.)

48430 HYDROGEN DISSOCIATION PRESSURE AT 400°C OF THE SYSTEM CALCIUM–LANTHANUM–HYDROGEN AT EQUIMOLAR CALCIUM-TO-LANTHANUM RATIO. Messer, C. E.; Miller, R. J. (Tufts Univ., Medford, Mass.). J. Less-Common Metals, 19: 284-6(Nov. 1969).

The possibility of the formation of a novel ternary hydride phase containing both calcium and lanthanum was investigated. The metals, with a molar Ca to La ratio of 0.5003 to 0.4997, were hydrided together. The hydrogen dissociation pressure at 400°C of the system Ca–H–La indicated that there was no phase change with changing hydrogen content. These results, along with previous crystallographic studies, strongly suggest that the system is single phase at least over the range of Ca to La ratios from 0.4 to 0.6. (G.M.C.)

48431 TUNGSTEN NEWS. SEPTEMBER 1969. Tungsten News, 1-18(1969).

The application of tungsten carbides in industry is discussed with special attention given to its successful use in cutting tools. Rams and seals of tungsten carbides have been produced. The properties of WC reviewed in recent applications include magnetic, machining, toughness, corrosion, oxidation, solubility, resistivity, and butt welding. The effects of additives on various properties of WC are discussed, along with the properties and uses of coatings containing WC. Production methods, new applications, and properties of tungsten metal and tungsten compounds other than tungsten carbides are reviewed. Recent data on tungsten-base alloys and tungsten as an alloying element are summarized. The production and recovery of tungsten are discussed. 201 references. (J.C.W.)

48432 DISCUSSION OF THE EFFECTS OF THE HYDROSTATIC PRESSURE IN A DEEP OCEAN ON THE MECHANICAL BEHAVIOUR OF METALS BY A. A. JOHNSON, T. LEWENSTEIN, AND E. A. IMBEMBO, WITH COMMENTS BY H. L. WAIN. THE EFFECT OF PRESSURIZATION ON THE TENSILE PROPERTIES OF POLYCRYSTALLINE MOLYBDENUM. Mellor, H. G.; Wronski, A. S. Ocean Eng., 1: 235-7(Feb. 1969).

The results of experiments to investigate the irreversible effects of hydrostatic pressure on the mechanical properties of as-recrystallized Mo are presented. The effects of pressurizations at 14, 20 and 29 kbar on the yield strength and ductile ⇌ brittle transition temperature are given and load elongation curves of Mo specimens tested at 148 to 190, 298, and 363°K in the as-recrystallized condition and following pressurization at 29 kbar are outlined. The ductile ⇌ brittle transition temperature was not significantly affected by 10 and 14 kbar pressures, but 20 kbar decreased the transition temperature in Mo by ~20°K and 29 kbar by ~50°K. A small decrease in the lower yield strength value was produced along with a very large decrease in the size of the yield point drop. (Metals Abstr.)

48433 NIOBIUM: DIFFUSION. Dragoo, A. L. (National Bureau of Standards, Washington, D. C.). At. Energy Rev., Special Issue No. 2, 187-202(July 1968).

Methods are described for studies on metallic ion diffusion, metalloid ion diffusion, and noble gas diffusion in solids. Experimental errors in diffusion studies are also discussed. Data on previous studies on diffusion in borides, carbides, nitrides, and oxides and diffusion in alloys are tabulated. (P.C.H.)

48434 FLOW AND FRACTURE OF MOLYBDENUM UNDER SPACE VACUUMS. Feuerstein, S. (Aerospace Corp., El Segundo, Calif.). Trans. Met. Soc. AIME, 245: 1903-7(Sept. 1969).

A model is postulated that accounts for the extended ductility of bulk polycrystalline molybdenum deformed at low pressures and in tension at ambient temperature; a hydrogen type of embrittlement mechanism is proposed. The model is based on previously published experimental data. The vacuum dependence of ductility is related to the rate of gaseous monolayer coverage and subsequent surface diffusion of mobile atoms onto available atomic sites. Occupation of free atomic sites impedes the release (also by diffusion) of contaminant gases from within the material and results in large internal pressures at crack sites at or near the surface. (auth)

48435 DEFORMATION OF Be–Cu SINGLE CRYSTAL UNDER HIGH PRESSURE. Hanafee, J. E.; London, G. J. (Franklin Inst. Research Labs., Philadelphia). Trans. Met. Soc. AIME, 245: 2113-14(Sept. 1969).

The combined effects of hydrostatic pressure and alloying high purity Be on the shear stress needed to cause pyramidal slip was investigated. It was found that hydrostatic pressure up to 14 kbars does not significantly affect the stress needed to cause slip in Be–2.5 wt % Cu alloys, but it does affect the operative fracture stress. (J.R.D.)

48436 EFFECT OF CRYSTALLOGRAPHIC ORIENTATION ON THE SURFACE FREE ENERGY AND SURFACE SELF-DIFFUSION OF SOLID MOLYBDENUM. Allen, B. C. (Battelle Memorial Inst., Columbus, Ohio). Trans. Met. Soc. AIME, 245: 2089-96(Sept. 1969).

Surface free energy and surface self-diffusion of solid molybdenum were studied in the temperature range 1600 to 2400°C using pressure-sintered bicrystals. Comparison of groove angles formed in various surfaces perpendicular to the grain boundary indicate a maximum of 1% variation in surface free energy with crystallographic orientation. This anisotropy tends to decrease with increasing temperature. The surface diffusion of the bicrystals is equivalent to that of sheet with a mild (100) preferred orientation. Anomalously low values found for bicrystals with surface orientations of (001), (012), and (011) are rationalized in terms of anisotropy in surface free energy. (auth)

48437 REFLECTIVITY MEASUREMENTS OF ZIRCONIUM. Larson, L. T. (Univ. of Tennessee, Knoxville, Oak Ridge National Lab., Tenn.). Trans. Met. Soc. AIME, 245: 2047-50(Sept. 1969).

The spectral reflectivity of zirconium in light of 441 to 668 nanometers (nm) wavelengths and air immersion has been determined. Bireflectance and apparent-angle-of-rotation measurements show zirconium to be optically isotropic when examined in light of approximately 484 nm wavelength. There is a direct relationship between bireflectance and the tilt of the basal pole of zirconium from the surface normal. This relationship allows the determination of the spatial orientation of the basal pole of an individual single crystal within a coarse-grained polycrystalline section to within ±2 to 3° for angles of basal pole tilt from 0 to 90°. (auth)

48438 PLASTIC DEFORMATION AND FRACTURE IN FeCo–2 PCT V. Jordan, K. R.; Stoloff, N. S. (Rensselaer Polytechnic Inst., Troy, N. Y.). Trans. Met. Soc. AIME, 245: 2027-34(Sept. 1969).

The temperature and grain size dependence of the mechanical properties of ordered and disordered Fe-49% Co-2% V were investigated. The yield and flow stresses obeyed the Hall-Petch relationship $\sigma = \sigma_i + kd^{-\frac{1}{2}}$. Ordering reduced the intercept stress σ_i and raised the Petch slope, k, at all temperatures. Ordering also increased the temperature dependence of k. The ductile to brittle transition temperature increased with order and grain size. Cleavage fracture was nucleation limited and the fracture stress did not vary linearly with $d^{-\frac{1}{2}}$. A quantitative test of the Cottrell–Petch fracture theory (and recent modifications which consider the influence of slip mode), demonstrated that this theory is not applicable to FeCo–V. (auth)

48439 MECHANICAL BEHAVIOR OF NIOBIUM (COLUMBIUM)–HYDROGEN ALLOYS. Westlake, D. G. (Argonne National Lab., Ill.). Trans. Met. Soc. AIME, 245: 1969-73(Sept. 1969).

Alloys of polycrystalline Nb-H have been tensile tested at 77 and 120°K after slow-cooling and after quenching from room temperature. A rationale has been developed to explain the effect of cooling rate on ductility in terms of microstructure. The inferior ductility of the slow-cooled alloys in this temperature range can be attributed to the precipitation of coarse hydride particles that fracture in the early stages of plastic deformation. Quenching produced much smaller hydride particles and a decreased tendency for initiation and propagation of cracks. Prismatic dislocation loops, punched into the matrix of quenched alloys, eliminate the yield point and may play some role in the low temperature ductility of the quenched alloys. The difference in ductility between quenched and slow-cooled V-H alloys was even greater than that observed in the Nb-H alloys. (auth)

48440 INFLUENCE OF PRECIPITATION ON THE SUPERCONDUCTING PROPERTIES OF A Tc–30 PCT V ALLOY. Koch, C. C.; Love, G. R. (Oak Ridge National Lab., Tenn.). Trans. Met. Soc. AIME, 245: 1957-62(Sept. 1969).

The changes in superconducting properties with aging time have been studied for the precipitation reaction in a Tc-30 at. % V alloy. Superconducting critical temperature, upper critical field, and relative critical current density were determined by ac susceptibility techniques. Aging produces changes in critical temperature of both matrix and precipitate which can be rationalized by compositional effects. Maximum flux pinning (critical current density) occurs at a time during aging when subgrain boundaries are completely decorated with precipitates and the subgrain centers remain precipitate-free. The particular effectiveness as barriers to flux motion of planar defects which enclose regions of low defect density is discussed. (auth)

48441 CRITICAL CURRENT ENHANCEMENT BY PRECIPITATION IN TANTALUM-RICH ZIRCONIUM ALLOYS. Pollock, J. T. A.; Gatos, H. C. (Massachusetts Inst. of Tech., Cambridge). Trans. Met. Soc. AIME, 245: 1953-6(Sept. 1969).

Critical current density enhancement by an order of magnitude was observed in tantalum-rich zirconium alloys (in magnetic fields at 4.2°K) after aging. Metallographic examination and superconducting transition temperature measurements showed that a continuous precipitation process occurs during aging and that the zirconium-rich precipitate formed is nonsuperconducting at 4.2°K. Over-aging led to a decrease in critical current density; the peak in superconducting behavior occurred at a particle size and particle separation of approximately 0.3 μ. These results are discussed in terms of matrix/precipitate interactions with flux filaments. (auth)

48442 HELIUM EMBRITTLEMENT OF A FERRITIC STAINLESS STEEL. Kramer, D.; Garr, K. R.; Pard, A. G. (Atomics International, Canoga Park, Calif.). Trans. Met. Soc. AIME, 245: 1909-12(Sept. 1969).

Helium was injected into small tensile samples of Type 405 stainless steel by α-particle irradiation from a cyclotron. Subsequent tensile testing at 550, 650, and 750°C revealed an increasing loss of total elongation with temperature which reached 55% at 750°C. The uniform elongation, unchanged by helium at 550 and 650°C, increased at 750°C in samples with helium. The presence of helium caused the failure mode to change from transgranular to intergranular failure at 750°C. The grain-boundary cracks originated as small voids adjacent to grain-boundary carbide particles. Large helium bubbles found attached to carbide particles are responsible for the void formation presumably through the action of grain-boundary sliding. (auth)

48443 RECOVERY AND RECRYSTALLIZATION OF TUNGSTEN PARTICLES CONTAINING A SMALL ADDITION OF NICKEL. Panichkina, V. V.; Skorokhod, V. V. pp 163-75 of II Konferencja Metalurgii Proszkow, 20–23 IX. 1967. Czesc I. Stolarz, S.; Missol, W.; Zolkowski, W.; Kurzeja, J.; Cyunczyk, A. (eds.). Krakow, Zakladzie Graficznym Politechniki Slaskiej w Gliwicach, 1967. (In Russian).

From 2nd Conference on Powder Metallurgy, Krakow, Poland. See CONF-670988-(Vol.1).

Ni and Pd accelerate the sintering of tungsten with rapid recrystallization taking place at 1100 to 1200°C. The change in fine crystalline structure of tungsten with the introduction of nickel was investigated on two types of samples. The first were ordinary samples pressed from 1 to 3 micron tungsten powder with and without the addition of an antirecrystallization agent. The second samples were prepared by sintering pressed tungsten briquettes at 1500°C followed by deformation under a press (porosity decreased from 38 to 6 to 8%). The amount of nickel additive was 0.3 to 0.5 wt %. The recovery processes were followed by x rays from the widening of the (110) and (211) lines. For the W + Ni and the W + Pd samples, densification began on heating above 950°C, continued intensively at 1200°C, and finished after about one hour. The deformed samples containing Ni showed a significant rise in mosaic size after 30 minutes at 1100°C, while the same type of sample without a nickel additive showed no increase in mosaic size. Nickel is a stronger activator than palladium. At 1200°C the block size of the mosaic structure increased by a factor of 5. (TTT).

48444 EFFECT OF THE GRAIN SIZE OF TUNGSTEN POWDER ON THE PROPERTIES OF RODS AND COARSE WIRES. Jesionek, B.; Ludynski, Z. pp 176-95 of II Konferencja Metalurgii Proszkow, 20–23 IX. 1967. Czesc I. Stolarz, S.; Missol, W.; Zolkowski, W.; Kurzeja, J.; Cyunczyk, A. (eds.). Krakow, Zakladzie Graficznym Politechniki Slaskiej w Gliwicach, 1967. (In Polish).

From 2nd Conference on Powder Metallurgy, Krakow, Poland. See CONF-670988-(Vol.1).

As a result of its high melting point of about 3400°C and other physical properties, tungsten found wide application in the production of incandescent lamps. The great hardness and extreme brittleness of tungsten renders the fabrication of wires difficult; pressing of the wires requires about 80 individual operations. The parameters involved in the hot pressing operation were examined.

Because of differences of the actual pressure at various points of the rod, the density of the compacted powder varied, resulting in cracks in the pressed bars, rods or wires; this in turn may cause deformations during the sintering process. Grain size of the powder exerted a great influence on the ultimate product. Grain growth was noted during the sintering process, regardless of whether the starting material had fine or coarse grains. The most coarse grain structure was observed with material prepared from 680 μ^2 size grains, pressed at 1.8 ton/cm^2. The wires fabricated from coarse-grained powers and pressed at a lower pressure exhibited worse plastic properties and a higher tendency toward cracking. (TTT)

48445 INVESTIGATION OF THE STRENGTH PROPERTIES OF Ni_3Al–Ni_3Nb ALLOYS AT HIGH TEMPERATURES. Arbuzov, M. P.; Kharchenko, V. K.; Chuprina, V. G. (Inst. of Problems in Material Studies, Kiev. Inst. of Problems of Stability, Kiev). Izv. Vyssh. Ucheb. Zaved., Fiz., No. 7, 55-9(1969). (In Russian).

Concentration dependence of the stability of Ni_3Al-Ni_3Nb for bending and compression at 20 to 1200°C and ductility at room temperature was studied. It was found that alloys with 45 and 90 wt % Ni_3Nb have the highest stability. (R.V.J.)

48446 SOLID-SOLUTION STRENGTHENING IN SINGLE CRYSTALS OF IRON ALLOYS. Takeuchi, Shin (National Research Inst. for Metals, Tokyo). J. Phys. Soc. Jap., 27: 929-40(Oct. 1969).

To elucidate the mechanism of the substitutional solid-solution strengthening of iron, evaluation of the modulus parameter and the direct observation of dislocation configuration were made for six alloy systems; Fe–Be, Fe–Al, Fe–Si, Fe–V, Fe–Ge, and Fe–Mo. The rate of the solid-solution strengthening at 300°K was best described as a function of the combined mismatch parameters by the equation $d(\tau/\mu)/dc = 0.04(\epsilon'_\mu + 1.5\epsilon_\alpha)^2$, where ϵ_α and ϵ'_μ are the size and the modulus mismatch parameter, respectively. The dislocations observed at the lower yield point were almost of screw type in all the alloys but their densities were extensively different from alloy to alloy. It was concluded that the elastic interaction of screw dislocations with the solute atoms was the dominant cause of the solid-solution strengthening of iron at 300°K. The wide variety of dislocation density was explained well by a proposed model in which it is determined by the condition for the applied stress to be minimum in a constant strain rate. (auth)

48447 ATOMS, ELECTRONS, AND FABRICATIVE PROPERTIES. pp 1-46 of Properties of Refractory Metals. Wilkinson, Walter D. New York, Gordon and Breach Science Publishers Inc., 1969.

Results of studies directed toward understanding of the similarities, differences, and interactions of V, Cr, Nb, Mo, Ta, and W on the basis of electron configuration are reported. The information is presented in discussions of atomic and electronic structure of refractory metals, thermal and electric properties, irradiation effects, and nuclear properties. (J.R.D.)

48448 TIME DEPENDENT MECHANICAL BEHAVIOR OF BERYLLIUM WIRE REINFORCED PLASTIC COMPOSITES. Mahieu, W. (Univ. of Dayton, Ohio); Schwartz, H. S. Sci. Advan. Mater. Process Eng. Proc., 12: AC.3.1-11(1967).

From 12th National SAMPE Symposium on Advances in Structural Composites, Anaheim, Calif. See CONF-671084.

The dependence of the mechanical behavior of beryllium wire reinforced plastic composites on duration of load (creep and stress-rupture), number of loading cycles (fatigue) and frequency of loading (vibration) was investigated. Where possible this behavior is compared with that of the constituent beryllium wire and other structural materials. The stress at which plastic deformation commences (elastic limit) in beryllium wire was determined. The influence of surface smoothness of beryllium wire on its static mechanical properties was also studied. (auth)

48449 TUNGSTEN-GROUP METALS AND ALLOYS. pp 245-300 of Properties of Refractory Metals. Wilkinson, Walter D. New York, Gordon and Breach Science Publishers Inc., 1969.

A review of compositions and properties of chromium and its alloys, molybdenum and its alloys, and tungsten and its alloys is presented. (J.R.D.)

48450 TANTALUM-GROUP METALS AND ALLOYS. pp 218-44 of Properties of Refractory Metals. Wilkinson, Walter D. New York, Gordon and Breach Science Publishers Inc., 1969.

A review of compositions and properties of vanadium and its alloys, niobium and its alloys, and tantalum and its alloys is presented. (J.R.D.)

48451 MECHANICAL AND DEFORMATION CHARACTERISTICS. pp 179-217 of Properties of Refractory Metals. Wilkinson, Walter D. New York, Gordon and Breach Science Publishers Inc., 1969.

Aspects of material development for producing specific service characteristics are reviewed. Discussions are included on service-related properties, fabrication-related properties, modules of elasticity, strain aging, and control of ductility by alloying. (J.R.D.)

48452 DUCTILITY AND BRITTLENESS. pp 132-78 of Properties of Refractory Metals. Wilkinson, Walter D. New York, Gordon and Breach Science Publishers Inc., 1969.

It is noted that a major consideration in fabrication of refractory metals often relates to ductility. Information on ductility is presented in discussions of transition parameters, measurement, mechanisms, effects of grain boundaries and size, effects of texture, effects of surface conditions, effects of interstitials, effects on mechanical working, and effects of atmosphere and impurities. (J.R.D.)

48453 THE INTERACTION OF TUNGSTEN WITH COPPER, MANGANESE, SILVER, AND TIN. Petrunin, I. E.; Grzhimal'skii, L. L. Metalloved. Term. Obrab. Metal., No. 1, 21-4(1969). (In Russian).

The reaction of W with Cu, Mg, Ag, and Sn under soldering conditions was studied. The soldering of W using solders of Cu, Mg, Ag, and Sn produces joints of great hardness. (L.C.L.)

48454 LOW-TEMPERATURE EMBRITTLEMENT OF REFRACTORY METALS. Gavrilyuk, M. I. Metalloved. Term. Obrab. Metal., No. 1, 14-18(1969). (In Russian).

The causes of low-temperature embrittlement of refractory metals were examined, and the influence of impurities on properties of these metals was evaluated. (tr-auth)

Structure and Phase Studies

Refer also to abstracts 47433, 47435, 47437, 47709, 48328, 48348, 48405, 48406, 48409, 48413, 48414, 48992, and 49004.

48455 (AECL–3372) EFFECT OF TEMPERATURE DURING DEFORMATION ON THE DEVELOPMENT OF TEXTURE IN ZIRCONIUM ALLOY ROLLED SHEET AND EXTRUDED TUBES. Cheadle, B. A.; Aldridge, S. A.; Ells, C. E. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). June 1969. 16p. Dep. CFSTI (U. S. Sales Only). CAN $0.50.

The crystallographic texture of a Zr–2.5 wt % Nb alloy has been determined after rolling at several temperatures. After cold rolling most of the basal plane normals are perpendicular to the plane of the sheet. When the material was held in the β-zirconium phase during rolling, then transformed to the α-zirconium phase, a component of basal plane normals was aligned in the rolling direction. Rolling experiments on a Zr–20 wt % Nb alloy showed that this was a direct result of the rolling texture formed in the β-zirconium. The temperature during extrusion also has an effect on the texture after extrusion, but the relation between rolling and extrusion textures has not been established. (auth)

48456 (BMI-X–517) CORRELATION OF DISLOCATION SUBSTRUCTURE WITH CREEP PROPERTIES IN REFRACTORY METALS. Final Report. Clauer, A. H.; Wilcox, B. A.; Hirth, J. P. (Battelle Memorial Inst., Columbus, Ohio). July 17, 1968. Contract W-7405-eng-92. 317p. Dep. CFSTI.

An investigation of creep in bcc metals is described. Mechanical creep properties and dislocation substructure developed during creep were studied. A comparison of observed creep behavior and creep substructure is made using existing creep theories. Single crystals of Mo were subjected to tensile creep at 0.5 to 0.76 Tm where Tm is the absolute melting temperature. Data and information on activation energies, dislocation substructures, and slip are included. (J.R.D.)

48457 (CEA-CONF–1318) CHANNELLING PATTERNS IN METALLIC CRYSTALS. Jousset, Jean-Claude; Mory, Jean; Quillico, Jean-Jacques (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). [1969]. 10p. (In French). (CONF-690522–2). Dep. CFSTI (U. S. Sales Only).

From International Meeting on the Study of Charged Particle Tracks in Solid Insulators and Their Application, Clermont-Ferrand, France.

Channelling in crystals has been studied using the possibility of recording alpha particles in cellulose nitrate. These alpha particles are isotropically emitted by an americium-241 source ($E_{max} \simeq 4.5$ MeV). A thin foil of the metal in study (polycrystal)

is set on the source. The channelled particles are recorded in a foil of cellulose nitrate. Many applications of this method are available in metallurgy like metallographic studies or defects studies in irradiated crystals. Some geometric features appear frequently in these "canaligraphies." Their geometry (triangles, crosses) can be related to the crystallographic texture of the sample. These patterns are made by the numerous impacts, on the cellulose nitrate, of those alpha particles which go through the crystal by planar channelling. Some low temperature studies of these geometrical patterns show that cellulose nitrate is able to record under vacuum the tracks of alpha particles at temperatures as low as 4.2°K. (auth)

48458 (IS-T-322) LATTICE DYNAMICS OF SCANDIUM. Wakabayashi, Nobuyoshi (Ames Lab., Iowa). Aug. 1969. Contract W-7405-eng-82. 124p. Dep. CFSTI.

The phonon dispersion curves for scandium metal have been measured using the technique of inelastic neutron scattering. The triple axis spectrometer at the ALRR was used. The following branches of the phonon dispersion curves have been measured: (1) LA, LO, TA, TO along ΓA, (2) LA, LO, TA||, TO||, TA⊥, TO⊥ along ΓM, (3) TA⊥, and TO⊥ along ΓKM. A modified axially symmetric model involving interatomic force constants out to 6th neighbors has been fitted to the data and used to obtain a frequency distribution function for scandium metal. The Debye temperature calculated from this model is in reasonably good agreement with other experiments. All the interatomic force constants were found to be of the same order of magnitude except for the 4th neighbor force constants, indicating long range interactions between the atoms. A Kohn type anomaly has been observed in the LA branch along ΓA and analyzed in detail. The relation of the anomaly to magnetic ordering in alloys of scandium with magnetic rare-earth metals is investigated using the concept of the generalized susceptibility $\chi(Q,\omega)$. Both of these effects are correlated to the nested region of the Fermi surface of scandium. The effect of the resolution ellipsoid on the peak shape of a scattered neutron group has been discussed in detail. A search has been made for paramagnon-like excitations associated with the conduction electrons at room temperature and 4°K with negative results. (auth)

48459 (KFK-935) PRECIPITATION BEHAVIOR IN NICKEL–VANADIUM ALLOYS. Kramer, K.-H. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material- und Festkoerperforschung). Feb. 1969. 82p. (In German). Dep.

The investigation of the precipitation behavior of Ni–V alloys with 15.4 and 16.5 wt.% V showed that only the tetragonal Θ equilibrium phase was precipitated. It was a matter of an ordered phase of structure type $TiAl_3$, which was coherent at the beginning of the precipitation with the matrix. The orientation relation between matrix and precipitation determined by electron microscopic diffraction pictures showed that both lattices lie parallel. With longer precipitation a deformation occurred and the precipitated particles were arranged in rows. They consisted of (101) habitus planes. The formation of this boundary surface between matrix and precipitation was dependent on the boundary surface and deformation energy and on the chemical binding energies. In the modification of the particle form, a transition from coherent to semi-coherent boundary surfaces was found. The value of 0.5 to 1.0 for the precipitation exponent was concluded from the thickness growth of disc particles or the length growth of cylindrical particle. The activation energy of the precipitation, which was determined from hardness and resistance curves, was 50 kcal/mole. A value of about 50 kcal/mole was obtained for the oxidation activation energy. Several oxide layers with different composition arose in the oxidation of Ni–V alloys. The external layer consisted of NiO and to a slight degree of $Ni(VO_3)_2$. A layer of V_2O_3 was connected. An attempt was made to explain the formation of heterogeneous oxide layers on the basis of thermodynamic and kinetic considerations. (tr-auth)

48460 (NP-18014) X-RAY STUDIES ON BINARY ALLOYS OF ALUMINIUM WITH PLATINUM METALS. Edshammar, Lars-Erik (Stockholm Univ. (Sweden). Inst. of Inorganic and Physical Chemistry). 1969. 51p. Dep. CFSTI (U. S. Sales Only).

Crystal structure studies of the platinum metal aluminides, previously reported in nine papers, are summarized and discussed. The discussion also includes several related compounds, including other transition metal aluminides. Intermediate phases in the systems and the crystal chemistry of the aluminides are surveyed. The bonding in the platinum metal aluminides is discussed. (D.L.C.)

48461 (NYO-3789-8) X-RAY STUDY OF THE PRECIPITATION OF HYDROGEN IN VANADIUM. Bonfiglioli, A.; Batterman, B. W. (Cornell Univ., Ithaca, N. Y. Materials Science Center). Aug. 20, 1969. 14p. Dep. CFSTI.

An investigation of impurity hydrogen effects on vanadium single crystals is reported. Results indicate that the precipitation is the final stage of a nucleation and growth process. (J.R.D.)

48462 SPECIFICATION OF THE BOUNDARY OF MONOPHASE REGION OF γ-SOLID SOLUTION IN THE TERNARY SYSTEM W–Ni–Fe. Agababova, V. M.; Chaporova, I. N. (All-Union Scientific-Research Inst. of Hard Alloys, Moscow). Porosh. Met., Akad. Nauk Ukr., SSR, No. 7, 67-72(July 1969). (In Russian).

The solubility of tungsten was investigated in γ- iron solid solutions in the ternary system W–Ni–Fe for the ratios Ni : Fe = 30 : 70, 40 : 60, 50 : 50, 60 : 40, 70 : 30, 80 : 20. The solubility of tungsten in γ-solid solution was measured and the solubility isotherms at 1350, 1250, 1150, and 800°C are plotted. (auth)

48463 CONSTITUTION OF THE ALLOYS OF THE RARE EARTH METALS WITH TRANSITION METALS, PARTICULARLY 3 d-METALS. Kirchmayr, Hans Rudolf (Technische Hochschule, Vienna). Z. Metallk., 60: 699-708(Sept. 1969). (In German).

The main factors such as the atomic radius, the electronegativity, and the heat of vaporization are discussed, which govern the shape and structure of the phase diagrams of the binary systems of rare earth metals with transition metals, placing special emphasis on thermodynamics. A discussion is given of the phase diagrams of binary and, also, ternary systems of rare earth metals with 3d-metals, especially manganese. (auth)

48464 FUEL FOR NUCLEAR POWER PLANTS. Numminen, K. Sahko, No. 11, 281-6(Nov. 1968). (In Finnish).

The composition of uranium fuel for nuclear power plants is described. Considerations for optimizing fuel processing are discussed. (TSS) (UKAEA Info. Bulletin)

48465 THERMODYNAMIC STUDY OF PHASE STABILITY IN THE TRANSITION-METAL RICH PHASES OF THE THORIUM–IRON, THORIUM–COBALT, AND THORIUM–NICKEL SYSTEMS AND THE COPPER RICH PHASES OF THE THORIUM–COPPER SYSTEMS. Magnani, Nicholas J. Ames, Iowa, Ames Lab., 1968. 53p. (IS-T-264).

Thesis.

Solid electrolyte electromotive force cells have been used to determine the free energies, entropies and enthalpies of formation of several thorium-poor phases in the binary systems of thorium with iron, cobalt, nickel, and copper. These phases were Th_2Fe_{17}, Th_2Co_{17}, $ThCo_5$, Th_2Ni_{17}, $ThNi_5$, $ThNi_2$ and $ThCu_4$. The electrolyte which was used in the cells was CaF_2 which is an ionic conductor over the temperature range of the measurements (600 to 850°C) and over the range of partial pressures of fluorine encountered in this investigation. The cells were of the type: Th, $ThF_4|CaF_2|Th_4$, M, ThMx; Th, $ThF_4|CaF_2|ThF_4$, Th_2M_{17}, ThM_5; and Th, $ThF_4|CaF_2|ThF_4$, ThM_5, ThM_2 where M equals iron, cobalt, nickel, and copper for the first cell cobalt and nickel for the second one, and nickel for the last one. The data indicate a decreasing stability of equivalent intermediate phases in the Th–M systems from nickel to cobalt to iron. The data also suggest that there is a correlation between crystallographic data and thermodynamic data for these phases and that interactions between thorium and the nearest neighbor transition metals are the dominant interactions stabilizing these phases. (Disser. Abstr.)

48466 X-RAY DIFFRACTION EFFECTS ARISING FROM STACKING FAULTS IN ALPHA URANIUM. Krishnan, R. (Bhabha Atomic Research Centre, Bombay). Trans. Indian Inst. Metals, 21: 60-3(Dec. 4, 1968).

Alpha uranium has an orthorhombic crystal structure with four atoms per unit cell. The (001) planes follow a certain stacking sequence which can be designated by the stacking operators Δ = (0,2y,0), where the parameter y = 0.1025. Faults in this sequence have been experimentally observed before by thin film transmission electrons microscopy. The theory of x-ray diffraction from 2Δ faults occuring in uranium as a result of deformation has been worked out and it is shown that for K = 1 reflections, L_0 even peaks would broaden about 12 times as much as L_0 odd peaks. For 1Δ faults, it is shown that for K = 1, L_0 even peaks would broaden nearly 3 times as much as L_0 odd reflections. (auth)

48467 TERNARY SYSTEM ALUMINUM–MANGANESE–VANADIUM. Kopp, Wolf-Ulrich; Wachtel, E. (Max-Planck-Institut fuer Metallforschung, Stuttgart). Z. Metallk., 60: 713-19(Sept. 1969). (In German).

The aluminum-manganese-vanadium equilibria in the range from 25 to 60 at. % Al were determined. The surfaces of primary crystallization, the position of the lines of double saturation of the melt and the reactions were determined. The high temperature ϵ-Al-Mn phase is unstable when ternary additions exceed ~7.5 at. %

or ~5.0 at. % Ti. Complete solubility is observed between δ-Mn and α-V, and γ-Al-Mn and γ-Al-V phases, respectively. The equilibria of the ternary systems Al-Mn-V and Al-Mn-Cr are compared. (auth)

48468 METALLOGRAPHY OF ALUMINUM–URANIUM ALLOYS. Gentile, Erberto Francisco (Instituto de Energia Atomica, Sao Paulo, Brazil). Metalurgia (Sao Paulo), 24: 187-92(Mar. 1968). (In Portuguese).

Various U–Al alloys, containing 2, 5, 10, 13, 20, and 25% U, were made by dissolving U metal in liquid Al in a graphite crucible in an electric oven. The Al bath was protected against air by $(NH_4)C10_3$ and cryolite. Precautions were taken against porosity of ingots, caused by H_2 absorption. The molten alloy was emptied into graphite and cast iron molds, the heads of which were heated to prevent segregation of U and promote formation of UAl_3 crystals. Metallographic samples were mechanically polished, first with carborundum and then with 6 and 1 μ diamond paste. The microstructure was studied micrographically at 500 magnification after electrolytic action in an acetic acid–perchloric acid bath and after exposure to either a 10% HF solution or a 5% NaOH solution. The former attacks UAl_3 crystals selectively, allowing observation of UAl_4 crystals. Of interest are eutectic UAl solutions, which form alloys in which the UAl_4 lemallae are converted into spherules causing a decrease in hardness and increased plasticity. Alloys containing more than 25% U are transformed by addition of 3% Si, which causes greater retention of UAl_3 crystals and increased Al content of the matrix. (tr-auth)

48469 EFFECT OF MOLYBDENUM ON THE GRAIN SIZE AND WORKABILITY OF ARC-CAST TUNGSTEN. Barr, Robert Q.; Klaphaak, Daniel J. (Climax Molybdenum Co. of Michigan, Ann Arbor). Met. Soc. Conf., 41: 727-35(1967).

From Symposium on Physical Metallurgy of Refractory Metals, French Lick, Ind. See CONF-651025-(Vol.1)).

It has been demonstrated that the grain size of vacuum-arc-cast tungsten can be significantly reduced by additions of molybdenum. The optimum molybdenum addition is 4% for four-inch-diameter ingots with low residual carbon contents, and slightly below 4% for ingots containing 100 to 150 ppM carbon. A relationship was found to exist between the rate of melting and the as-cast grain orientation of vacuum-arc-cast tungsten ingots. High melting rates tended to produce an essentially radial columnar growth, while low melting rates tended to produce a columnar growth predominantly parallel to the ingot axis. Low-carbon unalloyed tungsten was not successfully extruded at temperatures in the range of 2200 to 2600°F. Low-carbon tungsten with a grain refining addition of 3.72% molybdenum was, however, successfully extruded at 2400 and 2600°F. (auth)

48470 STRUCTURAL DEVELOPMENT, IN THE COURSE OF ISOTHERMAL TEMPERING, IN THE ZIRCONIUM–NIOBIUM ALLOY CONTAINING 8 PERCENT BY WEIGHT OF NIOBIUM. Van Effenterre, Patrick; Llassotskaya, Violetta; Cizeron, Georges; Lacombe, Paul (Laboratoire de Metallurgie, Orsay, France. CEN, Saclay, France). Compt. Rend., Ser. C, 268: 2273-6(June 30, 1969). (In French).

Differential thermal and dilatometric analyses were used to follow the structural evolution of a Zr–Nb alloy with 8 wt.% Nb during isothermal tempering. The samples were tempered with water after homogenization at 850°C. Seven stages of structural evolution were detected. In the first stage from 20 to 110°C the alloy has not begun its evolution. The second stage is from 110 to 285°C and the characteristics of this stage indicate that the structural evolution of the alloy corresponds to the formation of the ω phase from the β phase retained by tempering to the metastable state. Stage III extends to 430°C and the ω phase is transformed into the ω′ phase. In stage IV from 430 to 550°C the structural evolution corresponds to the progressive transformation of ω′ into β. In stage V from 550 to 575°C the α phase appears. In stage VI the transformation into the β phase is achieved. In stage VII above 730°C the alloy is in the form of a solid β solution conforming to the equilibrium diagram. (J.S.R.)

48471 ON THE DECOMPOSITION OF A HIGHLY SUPERSATURATED Al–Zr SOLID SOLUTION. Izumi, O.; Oelschlaegel, D. (Research Inst. for Iron, Steel, and Other Metals, Sendai). Scr. Met., 3: 619-21(Sept. 1969).

Results of an investigation of the role of impurity Fe or Si on precipitation in cooled Al–1.1 wt % Zr alloy are presented. The precipitation sequence was found to be: solid solution → spherical particles statistically distributed ($L1_2$-structure) → rod shaped particles in fan arrangement → plates of tetragonal Al_3Zr. (J.R.D.)

48472 INTERMETALLIC COMPOUNDS IN THE Er–Zn SYSTEM. Michel, D. J.; Ryba, E. (Pennsylvania State Univ., University Park). Scr. Met., 3: 683-6(Sept. 1969).

Evidence for existence of three previously unreported compounds in the Er–Zn system is discussed. The compounds are $ErZn_3$, $Er_2Zn_{\sim 9}$, and $ErZn_{\sim 7}$. It is noted that complete structural details for these compounds will be published when they become available. (J.R.D.)

48473 TRANSMISSION ELECTRON MICROSCOPIC OBSERVATION OF THE RECRYSTALLIZATION PROCESS OF Al–Zr ALLOY. Yokota, M. Sumitomo Denki, No. 100, 46-54(July 1969). (In Japanese).

An electron microscopic study of the recovery and recrystallization processes of Al–Zr alloy was carried out. A collection of electron microscopic photographs is included. The recrystallization process of Al–Zr alloy is considered to be that of the coalescence and growth of subgrains and dissipation of subboundaries rather than that of the nucleation and growth mechanism. Furthermore, it is possible to say that the heat-resistant mechanism of Al–Zr alloy is attributed to the soluted Zr itself, at a lower temperature, and to the precipitates of Al_3Zr at a higher temperature. (auth)

48474 THE EFFECT OF ROLLING TEMPERATURE ON PREFERRED ORIENTATION IN TANTALUM. Cooper, T. D. (Air Force Materials Lab., Wright-Patterson AFB, Ohio); Spretnak, J. W. Met. Soc. Conf., 41: 681-703(1967).

From Symposium on Physical Metallurgy of Refractory Metals, French Lick, Ind. See CONF-651025-(Vol.1)).

A study has been made of the preferred orientations resulting in tantalum strip rolled at temperatures representing 0.1, 0.2, 0.4, and 0.5 times the absolute melting point (T_m), or 27, 381, 1036, and 1363°C, respectively. The data are presented in the form of {110} pole figures determined using x-ray reflection techniques. The textures resulting from rolling at 0.1 and 0.2 T_m are described as a spread between the {100} ⟨011⟩ and the {112} ⟨011⟩ texture, with rotation about ⟨011⟩ as an axis, and a secondary component {111} ⟨112⟩, which may alternately represent a spread between {111} ⟨011⟩ and {111} ⟨112⟩ with rotation about an axis normal to the {111} plane. Rolling at the higher temperatures results in the introduction of and strengthening of a component near {110} ⟨001⟩, with a corresponding decrease in the {100} ⟨011⟩ component and complete disappearance of the {111} ⟨112⟩ component. A {112} ⟨111⟩ secondary component is observed. The cause for the change in texture at the higher temperatures is not apparent, but may represent a compromise between a deformation and a recrystallization texture. It may also be a recrystallization texture which, if true, would indicate that impurities play a major role in the development of recrystallization textures in tantalum. (auth)

48475 INTERSTITIAL SINK EFFECTS IN THE REFRACTORY METALS. Metcalfe, A. G.; Dunning, J. S. (Solar Division of International Harvester Co., San Diego, Calif.). Met. Soc. Conf., 41: 943-58(1967).

From Symposium on Physical Metallurgy of Refractory Metals, French Lick, Ind. See CONF-651025-(Vol.2)).

Interstitial sink occurs in metals and alloys under conditions such that the partial molal free energy of the interstitial element in solution is low enough that the interstitial elements concentrate in this metal or alloy. Indications of the causes of this phenomenon are discussed and results obtained in thermal experiments are presented in which foils of sink elements Mo, W, Ta, and Ti were bonded to Nb alloys. (J.R.D.)

48476 SOME OBSERVATIONS ON THE ROLE OF GRAIN BOUNDARIES IN HIGH TEMPERATURE DEFORMATION AND FRACTURE OF REFRACTORY METALS. Begley, R. T.; Godshall, J. L. (Westinghouse Astronuclear Lab., Pittsburgh). Met. Soc. Conf., 41: 843-60(1967).

From Symposium on Physical Metallurgy of Refractory Metals, French Lick, Ind. See CONF-651025-(Vol.2)).

Observations on grain boundary sliding and intercrystalline fracture are described for niobium alloys. It appears that the general trend of behavior observed applies to all refractory metals and alloys. Intercrystalline fracture and void formation have been noted in high temperature tensile tests on tungsten. More detailed studies of grain boundary sliding and intergranular fracture in the refractory metals, with particular reference to the effect of precipitates and the role of solute segregation on grain boundary sliding and migration, should be undertaken. These studies can be expected to contribute greatly to the development of alloys with optimum creep resistance and satisfactory fracture ductility. (auth)

48477 INVESTIGATION OF THE KIRKENDALL EFFECT IN POROUS ALLOY IONIZERS. Dewey, C. F. Jr. (Univ. of Colorado, Boulder); Adams, F. R. Met. Soc. Conf., 41: 1281-1302 (1967).

From Symposium on Physical Metallurgy of Refractory Metals, French Lick, Ind. See CONF-651025-(Vol.2)).

The lifetime of stable porosity in a refractory metal compact can be immensely increased by exploiting the Kirkendall effect which occurs between constituents differing significantly in their intrinsic diffusion coefficients and lattice parameters. For the conditions investigated, the mean pore size increased during sintering in contrast to the monotonic densification observed in single-component systems. It is not possible at the present time to extrapolate the precise sintering behavior of W–Ta compacts of arbitrary particle size and composition, although the basic diffusion mechanisms are believed to be known. It appears that further research on the W–Ta binary system could produce "tailored" compacts whose sintering history and resultant pore structure were optimized with respect to specific requirements. The results of experiments using small Ta additions to W suggest that this is a possibility. An extension of these results to other systems exhibiting the Kirkendall effect (e.g., tungsten-rhenium) also appears promising. (auth)

48478 DIFFUSION AND ELECTRON EMISSION PROPERTIES OF DUPLEX REFRACTORY METAL THERMIONIC EMITTERS. Hudson, R. G.; Yang, L. (General Dynamics Corp., San Diego, Calif.). Met. Soc. Conf., 41: 1253-79(1967).

From Symposium on Physical Metallurgy of Refractory Metals, French Lick, Ind. See CONF-651025-(Vol.2)).

An evaluation of Re–W and Ir–W duplex emitter systems revealed that in the temperature range of thermionic interest (1600 to 1800°C), the Re–W system forms two intermediate phases, the × phase and the σ phase; while the Ir–W system forms one intermediate phase, the ϵ phase. There is appreciable interdiffusion between the components of both these systems in the temperature range of 1600 to 1800°C during the designed operating life of these emitter systems, e.g., 10,000 hours. The widths of the diffusion zones and the intermediate phases of the Re–W and the Ir–W systems after 10,000 hours at various temperatures are calculated and plotted. It is noted that for the Re–W system, the total width of the σ phase and the × phase is 6 mils at 1600 and 12 mils at 1800°C; while the total width of the diffusion zone is 14 mils at 1600 and 25 mils at 1800°C. For the Ir–W system, the width of the ϵ phase is 10 mils at 1600 and 18 mils at 1800°C, and the total width of the diffusion zone is 12 mils at 1600 and 24 mils at 1800°C. Therefore, from the point of view of the width of the diffusion zone, a Re or Ir layer of at least 15 mils in thickness is needed at 1600 and at least 30 mils in thickness is needed at 1800°C. The formation of intermediate phases between the Re or the Ir emitting layer and the W substrate limits the usefulness of the duplex emitter concept for these materials. Voids and cracks may be present in these phases, especially upon thermal cycling, which impairs the mechanical integrity and the heat transfer property of the duplex emitter structure. (auth)

48479 REACTIONS OF GRAPHITE WITH TUNGSTEN AND TUNGSTEN–25 w/o RHENIUM. Fackelmann, J. M.; Getz, R. W.; Moak, D. P. (Battelle Memorial Inst., Columbus, Ohio). Met. Soc. Conf., 41: 335-47(1967).

From Symposium on Physical Metallurgy of Refractory Metals, French Lick, Ind. See CONF-651025-(Vol.1)).

Graphite and tungsten react to form single-phase layers of WC and W_2C when heated in contact with each other at temperatures of 1500 to 2200°C. The rate of growth of these layers is predictable within certain limits, and can be expressed as a parabolic-rate function of reciprocal temperature, with an activation energy of 107,600 cal/mol calculated from the data for the over-all process. The reaction products between graphite and tungsten-25 wt % rhenium at temperatures of 1500 to 1900°C are WC, W_2C, and sigma. Most of the diffusion layer growth that occurs in this case consists of the two-phase band W_2C + sigma. As with tungsten, the growth rate of the total layer is predictable. The parabolic rate of layer growth in this case proceeds at a rate that varies from ten times the rate with unalloyed tungsten at 1500°C to a factor of three times greater at 1900°C. The difference is postulated as being principally due to a much higher rate of carbon transport associated with the presence of sigma phase in the two-phase layer. The activation energy calculated from the data for the process in tungsten-25 wt % rhenium is 80,600 cal/mol. These results highlight the fact that improvements in mechanical properties of a structural material, like tungsten, by means of an alloying addition can lead to more complex chemical reactions. In the case studied, the much more rapid growth of carbide layers in tungsten-25 wt % rhenium than in tungsten might seriously inhibit the usefulness of this alloy in structural applications involving graphite. (auth)

48480 STRUCTURE OF NIOBIUM–TITANIUM–HYDROGEN ALLOYS. Stalinski, B.; Nowak, B.; Zogal, O. J. (Inst. of Low Temperature and Structure Research, Wroclaw). J. Less-Common Metals, 19: 289-90(Nov. 1969).

Preliminary results of x-ray and proton NMR studies on the H–Nb–Ti system are reported. The samples were prepared by direct hydrogenation of bcc Nb–Ti alloys obtained by arc melting appropriate sintered mixtures containing 10 to 50 at. % titanium. X-ray and proton NMR investigations confirmed the existence of the fcc γ-phase to be niobium–titanium dihydride with fluorite type structure. (G.M.C.)

48481 HOLMIUM–COBALT SYSTEM. Buschow, K. H. J.; Van Der Goot, A. S. (Philips Research Labs., Eindhoven, Netherlands). J. Less-Common Metals, 19: 153-8(Nov. 1969).

The holmium–cobalt system was investigated over the whole concentration range by means of x-ray diffraction, thermoanalysis, and metallography. The following intermetallic compounds were identified: Ho_3Co, Ho_xCo ($x \approx 7/4$), Ho_4Co_3, $HoCo_2$, $HoCo_3$, Ho_2Co_7, $HoCo_{5.5}$, and Ho_2Co_{17}. For all compounds except Ho_xCo the crystal structure and the lattice constants are given. For the compounds $HoCo_{5.5}$ and Ho_2Co_{17} large homogeneity regions existed at elevated temperatures. The compound $HoCo_{5.5}$ was not stable below 1150°C. (auth)

48482 INVESTIGATION OF ORDERING OF INTERSTITIAL IMPURITIES IN TANTALUM USING AN ELECTRON DIFFRACTION MICROSCOPE. Usikov, M. P.; Khachaturyan, A. G. (Central Scientific Research Inst. of Ferrous Metallurgy, Moscow). Sov. Phys.-Cryst. (Engl. Transl.), 13: 910-18(May-June 1969).

Translated from Kristallografiya, 13: 1045-55(Nov.-Dec. 1968).

An electron-microscopic investigation was made of ordered interstitial solutions of oxygen and nitrogen in the bcc lattice of tantalum. The results obtained are analyzed by means of a method suggested for calculating the intensities of superlattice reflections whose existence is connected with scattering of radiation by displaced atoms of the solvent. These displacements are due to interstitial atoms and are distributed in accordance with their spatial arrangement. A combined analysis of the electron-diffraction pattern and the diffraction contrast in the micrograph made it possible to establish the structure of the unit cells of the interstitial superlattices in the Ta–O and Ta–N systems, and the structures of the domain in boundaries in the Ta–O system. It is shown that the different interstitial superlattices which were found in the Ta–O system (Ta_4O and $Ta_{16}O$) can be obtained from a superlattice of the Ta_2O type if one removes some of the oxygen atoms from its unit cell in a definite manner. In the superlattice of Ta_2O also, it was established that the oxygen atoms occupy one of the bcc interstitial sublattices; every other one of the parallel planes (110) is occupied by oxygen. Analysis of the diffuse scattering made it possible to elucidate which of the interstitial sublattices is occupied by oxygen atoms. Thus, the ordered phases of the type Ta_4O and $Ta_{16}O$ can be considered as the result of successive stages of ordering in a superlattice of the Ta_2O type when there is an oxygen deficiency, as compared with the stoichiometric composition of the Ta_2O phase. In the Ta–N system only one superlattice was detected; it corresponds to the composition Ta_9N. In this superlattice the nitrogen atoms are situated in three sublattices of octahedral interstices. (auth)

48483 WORK SOFTENING OF ZINC AND OTHER HEXAGONAL METALS AND CREEP OF ZINC. Deighton, M.; Parkins, R. N. (Univ. of Newcastle-upon-Tyne, Eng.). Trans. Met. Soc. AIME, 245: 1917-27(Sept. 1969).

The metals Cd, Mg, Sn, Tl, Zn, and Zr reach a peak hardness after a critical deformation by rolling and then soften with further rolling, thereby exhibiting work softening. Optical metallography on Cd, Mg, and Zn shows that work softening is accompanied by a change in grain size occurring during deformation. The creep of zinc from −11 to +60°C at stresses in the range of 7.9 to 17.3 kg per sq mm is given by $\epsilon = \epsilon_0 + \beta t + Kt + \alpha t^{\frac{1}{3}}$. The third and second rate constants are related by the equation $\alpha = 10^{-4} K^{\frac{1}{3}}$ and their stress and temperature dependence can be represented by the equations $K^{\alpha} = A_0 \cdot \exp - (U_0 - B\sigma)/kT$. A model based upon the stress activated glide of sub-boundaries is proposed which qualitatively accounts for the metallographic observations. Expressions, which are in reasonable quantitative agreement with the experimental observations, are derived for the creep of zinc. (auth)

48484 SOLID SOLUTION HARDENING IN NIOBIUM (COLUMBIUM) AND TANTALUM. Kostorz, Gernot (Argonne National Lab., Ill.). Trans. Met. Soc. AIME, 245: 2102-4(Sept. 1969).

An evaluation of plateau stress data on Nb and Ta alloys in

terms of the modulus defect and the critical resolved shear stress is presented. Data on plateau hardening and alloy parameters for Nb are tabulated along with solid solution hardening and alloy parameters for Ta alloys. (J.R.D.)

48485 INTERACTION OF SLIP DISLOCATIONS WITH TWINS IN HCP METALS. Yoo, M. H. (Oak Ridge National Lab., Tenn.). Trans. Met. Soc. AIME, 245: 2051-60(Sept. 1969).

Possible interactions of the perfect dislocations of six slip systems or the c dislocation with the $\{10\bar{1}2\}\langle 10\bar{1}1\rangle$, $\{10\bar{1}1\}\langle 10\bar{1}2\rangle$, $\{11\bar{2}2\}\langle 11\bar{2}3\rangle$, and $\{11\bar{2}1\}\langle 11\bar{2}6\rangle$ type twins in hcp metals have been analyzed from the crystallographic and the energetic points of view. Twenty-six distinct types of possible interactions were identified, and those selected based on crystallographic constraints were examined for their energetic feasibilities by use of the anisotropic energy factors. No long-range elastic interaction exists for a dislocation when its Burgers vector is parallel to the twin interface. Under a suitable applied stress, a screw dislocation can cross slip at the twin interface. For basal mixed dislocations in cadmium and zinc, the interaction with $\{10\bar{1}2\}$ twins is found to be attractive, indicating that incorporation of these dislocations into the twins is energetically feasible and that twin growth will result. On the other hand, the interaction between both basal and prism mixed dislocations and the $\{10\bar{1}2\}$ and $\{11\bar{2}1\}$ twins is found to be repulsive in Mg, Co, Re, Zr, Ti, Hf, and Be. This indicates that under an applied stress a local stress concentration will develop due to a dislocation pileup at the interface, which may result in a site for either the nucleation of other twins or the formation of a crack, depending on the cleavage strength. (auth)

48486 PRECIPITATION HARDENING OF FERRITE AND MARTENSITE IN AN Fe–Ni–Mo ALLOY. Peters, D. T.; Floreen, S. (International Nickel Co., Inc., Suffern, N. Y.). Trans. Met. Soc. AIME, 245: 2021-6(Sept. 1969).

The age hardening behavior of an Fe–8Ni–13Mo alloy was studied after the matrix had been varied to produce either ferrite, cold worked ferrite, or massive martensite. The aging behavior of the cold worked ferrite and martensite structures were very similar. The martensite aging kinetics were much different from those observed in earlier studies of aging of maraging steels, even though the martensite matrix had the same dislocation structure as those found in maraging steels. The results suggest that the previously observed precipitation kinetics of maraging steels may have been controlled by the nucleation behavior, which in turn were dictated by the alloy compositions and the resultant identities of the precipitating phases. (auth)

48487 LIQUID IMMISCIBILITY IN BINARY INDIUM ALLOYS. Dasarathy, Cuppam (British Steel Corp., Glamorgan, Eng.). Trans. Met. Soc. AIME, 245: 2015-19(Sept. 1969).

The incidence of liquid immiscibility in binary indium alloys has been theoretically analyzed on the basis of the Hildebrand–Mott equation. Predictions of miscibility or otherwise have in general been found to agree with those phase diagrams that are already published in the literature. Out of a total of 27 systems, where either the complete phase diagrams are published or liquid immiscible behavior is reported, the predictions agree with the experimental data in 25 systems, the exceptions being the Te–In and Ni–In systems. According to the equation, liquid immiscibility is also indicated in the binary alloys of indium with K, Rb, Cs, Na, Sr, Ba, Ti, Zr, V, Nb(Cb), Ta, W, U, Re, Ru, Rh, Os, and Ir. (auth)

48488 EFFECTS OF THE TERNARY ADDITIONS: O, Sn, Zr, Cb, Mo, AND V ON THE $\alpha/\alpha + Ti_3Al$ BOUNDARY OF Ti–Al BASE ALLOYS. Crossley, F. A. (Lockheed Missiles and Space Co., Palo Alto, Calif.). Trans. Met. Soc. AIME, 245: 1963-8(Sept. 1969).

Oxygen, Zr, Nb, Mo, and V were found to shift the $\alpha/\alpha + Ti_3Al$ boundary to higher titanium content—that is, the total of substitutional solutes soluble in the α was decreased. However, more tin plus aluminum atoms were found to dissolve in primary α than aluminum atoms alone. (auth)

48489 EFFECT OF HEAT TREATMENT ON THE TEMPERATURE OF TRANSITION TO THE SUPERCONDUCTING STATE OF NIOBIUM–ZIRCONIUM ALLOYS. Baron, V. V. pp 42-4 of Metallography, Physical Chemistry, and Metal Physics of Superconductors. Moscow, Izdatel'stvo Nauka, 1967. (In Russian).

Cold-strained niobium–zirconium alloys containing 25 and 50 at.% Zr were annealed at 500 to 900°C for various periods of time and investigated for the critical temperature (T_{cr}) of the transition to the superconducting state. Preliminary experiments showed that electron-beam melted niobium had a T_{cr} of 9.4°K which increased to 11.5°K in niobium alloys containing 25 to 27 at.% Zr, and decreased to 7.5°K with 80 at.% Zr. The initial cold-strained alloys had the structure of a high-temperature β-solid solution with a bcc lattice and a lattice constant of 3.37 Å in the alloy containing 25% Zr and 3.42 Å in the alloy containing 50% Zr. The annealing-induced decomposition of the β-solid solution in these alloys proceeded at a higher rate than in cast alloys. Annealing at 900°C for 15 min caused precipitation of the β_1-phase in the alloy containing 25% Zr. With increasing annealing time to 60 min, the alloy structure consisted of the β_1 and β_2 phases. These phase transformations affected the T_{cr} of the alloys very little, since the chemical composition of the β_1 and β_2-phases differed only slightly from that of the β-solid solution. With decreasing annealing temperature, the difference in the chemical composition of the initial and resulting phases became more pronounced and the T_{cr} decreased significantly. The T_{cr} of the alloy containing 50 at.% Zr increased from 9.4 to 11°K with annealing at 860°C for 1 hr due to the precipitation of niobium-enriched β_1-phase. Annealing at 500°C for 150 hr increased the T_{cr} of the alloy containing 50 at.% Zr to 10.4°K. In this case, after precipitation of the hexagonal α-phase, the β-phase contained more than 55% Nb. Thus, the T_{cr} of variously heat treated single-phase Nb–Zr alloys depends on the phase composition. In alloys with a two-phase structure, the change in the critical temperature is determined also by the amount and composition of precipitated phases. (JPRS)

48490 PRECIPITATION REACTIONS AND STABILITY OF Ni_3Nb IN INCONEL ALLOY 718. Boesch, W. J.; Canada, H. B. (Special Metals Corp., New Hartford, N. Y.). J. Metals, 22: 34-8(Oct. 1969).

Data presented in current literature attribute many desirable properties of Inconel Alloy 718 to sluggish precipitation of the niobium rich intermetallics. Original time-temperature-transformation curves indicate the precipitation of Ni_3Nb initiated in five to ten hours in the temperature range commonly used for solution heat treatment. This presentation shows that Ni_3Nb precipitates in less than 0.2 hr at 1700°F. The chemical composition and structure for Ni_3Nb are presented. The chemical and morphological stability of this phase are discussed. The change from the spheroidal hardening precipitate to the acicular Ni_3Nb is also shown. The presentation also discusses the composition and stability of the MC carbide and indicates the precipitation of NbC. The precipitation of Ni_3Nb and its upper stability limit are discussed. (auth)

48491 EVALUATION OF ATOMIC DISTRIBUTION IN LIQUID METALS AND ALLOYS BY MEANS OF X-RAY-, NEUTRON-, AND ELECTRON-DIFFRACTION. Steeb, Siegried (Max-Planck-Inst. for Metal Research, Stuttgart). Ergeb. Exakten Naturwiss., 47: 1-66(1968).

The diffraction procedures used to explore the structure of molten elements and alloys are reviewed. Experimental procedures are described for the diffraction methods and for determining coordination numbers and partial structure factors. Results of structure investigations are summarized for metals, semimetals, and alloys. Methods and models for interpreting the results are described. 341 references. (D.L.C.)

48492 INTERSTITIALS AND THEIR EFFECTS ON PROPERTIES. pp 93-131 of Properties of Refractory Metals. Wilkinson, Walter D. New York, Gordon and Breach Science Publishers Inc., 1969.

Techniques of excluding entry of interstitial elements in refractory metals are discussed along with methods of minimizing their effects. (J.R.D.)

48493 RECRYSTALLIZATION ON DIAGRAMS OF ALLOYED MOLYBDENUM. Kopetskii, Ch. V.; Pridantsev, M. V.; Smolyakova, L. G. Metalloved. Term. Obrab. Metal., No. 1, 18-21 (1969). (In Russian).

Molybdenum alloys which were obtained by powder metallurgy methods were studied. The recrystallization diagrams of these alloys showed that additions of Fe and of Fe–Ni powder resulted in smaller grain size, while Ni additions increased the grain size, and Co additives promoted the formation of polygon-shaped crystals. (tr-auth)

Radiation Effects

Refer also to abstracts 48442 and 48576–48578.

48494 (CEA-CONF-1304) RADIATION DAMAGE FROM PILE NEUTRONS. NEUTRON FLUX AND INDUCED DAMAGE.

Genthon, J. P. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Mar. 1969. 15p. (In French). (CONF-690620-4). Dep. CFSTI (U. S. Sales Only).

From Symposium on Radiation Damage in Solids and Reactor Materials, Vienna, Austria.

The source S is measured as directly as possible through the use of a conveniently chosen physical effect M, by displacements induced in a solid by a neutron flux. An experimental and theoretical analysis is given of how this source is bound to the spectral distribution $\varphi(E)$ of this flux. If $\phi_r(Z)$ is the equivalent distribution of $\varphi(E)$ for an effect Z, such that S(Z) is proportional to $\phi_r(Z)$, it can be shown how this flux $\phi_r(Z)$ is defined, either from the flux of neutrons with energy greater than a threshold S, or for pile thermal neutrons by correlation with the results of activation detector measurements of thermal, intermediate, and fast neutron relative flux distributions. The method is to measure, at ambient temperatures, the variation of electric resistivity $\Delta R/R$ of samples; the results reported concern tungsten in fast fluxes between $6(10)^{14}$ and $5(10)^{20}$ n/cm^{-2} (where $\Delta R/R$ is between $6(10)^{-5}$ and 2), graphite, and titanium. Another method in its early stages is that of canalization of alpha particles. The interpretation shows the validity of the model used concerning the ionization phenomenon and seems to confirm the phenomenon of zone displacements; it is noted that the agreement of fast and thermal neutron effects is overestimated in the calculation which takes into account only the energy transferred to the system. (tr-auth)

48495 (CEA-CONF-1319) MEASURE OF THE AVERAGE RANGE OF FISSION FRAGMENTS WITH MICA AS A DETECTOR: INFLUENCE OF CRYSTAL STRUCTURE. Mory, Jean; De Guillebon, Dominique; Delsarte, Guy (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). [nd]. 8p. (In French). (CONF-690522-3). Dep. CFSTI (U. S. Sales Only).

From International Meeting on the Study of Charged Particle Tracks in Solid Insulators and Their Application, Clermont-Ferrand, France.

Mica is used for the measurement of the average distance covered by fission fragments of uranium-235 in various metals. This determination has for its purpose the determination of fissile elements in alloys by means of tracks in mica. It is found, for hard-hammered states, in mg/cm^{-2}: Al: 2.84; Cu: 5.08; Pd: 5.32; Au: 8.50; Ti: 3.82; Zr: 4.70; Ag: 5140; Fe: 4.22; Nb: 4.78; Ta: 6.32; Ni: 4.40; Mo: 5.18; and W: 7.35. These results vary, with several exceptions, linearly with the square root of the atomic number of the element studied. The canalization effect on the distance covered is studied. Several samples are made to undergo thermal annealing, and it is shown that the distance covered depends significantly on the crystal structure of the absorber. (tr-auth)

48496 (EIR-151) POSTIRRADIATION EXAMINATION OF THE FIRST TEST ELEMENT (II) IRRADIATED IN THE LUCENS REACTOR. Stauffer, M. (Eidgenoessisches Institut fuer Reaktorforschung, Wuerenlingen (Switzerland)). Mar. 1969. 29p. (In French). Dep. CFSTI (U. S. Sales Only).

The test element II was disassembled and subjected to various post-irradiation examinations. These examinations showed that the test element behaved extremely well under irradiation. Its relatively low burn-up rate did not provoke significant material modifications. The uranium alloy was expanded perceptibly, but the cladding magnesium was almost unaffected. The Zircaloy-2 maintained its properties of elasticity and resistance, and the graphite was modified only to improve its permeability. (tr-auth)

48497 (GEAP-10026) SPECIFIC ZIRCONIUM ALLOY DESIGN PROGRAM. Quarterly Progress Report No. 24. Mehner, A. S.; Klepfer, H. H. (General Electric Co., San Jose, Calif. Nuclear Fuels Dept.). Apr. 1969. Contract AT(04-3)-189. 29p. (EURAEC-2118). Dep. CFSTI.

Work Performed under United States-Euratom Joint Research and Development Program.

A Zr + 2.0 at. % Cr + 0.16 at. % Fe alloy (Zr-Cr) was evaluated as nuclear fuel cladding. Zr-Cr alloy-clad fuel rods were irradiated in the Consumers Big Rock Point reactor to a target exposure of 20,000 MWd/tU. The rate of fuel burnup has been approximately 800 MWd/tU (average) per month of full-power operation. During the June-July 1968 reactor outage, the pool examination of the B-1 assembly indicated that the Zr-Cr and Zircaloy-2 test rods were performing satisfactorily after 8,000 MWd/tU bundle average exposure. Nine test fuel rods and two dummy rods were removed from the bundle and returned to Vallecitos Nuclear Center. The post-irradiation examination of these rods has been initiated. The assembly was reconstituted and the irradiation continued. As of March 31, 1969, the Zr-Cr rods inserted in June 1967 have accumulated an average exposure of 13,936 MWd/tU, and the replacement rods inserted in June 1968 have accumulated an average exposure of 5,936 MWd/tU. (auth)

48498 (IS-2127) THE EFFECTS OF NEUTRON IRRADIATION UPON THE STRENGTH AND DUCTILITY OF VANADIUM. Smolik, G. R.; Chen, C. W. (Ames Lab., Iowa). May 1969. Contract W-7405-eng-82. 59p. Dep. CFSTI.

The effects of neutron irradiation on the mechanical properties of pure vanadium were investigated by examining the stress-strain curves of tensile samples of vanadium irradiated to various doses of fast neutrons. The changes in the yield strength and elongation to fracture are related to the fluence. The same parameters are evaluated as a function of post-irradiation annealing. Also, the influence of testing temperature on irradiation strengthening is examined. Of particular interest is the temperature dependence of the increase in the flow stress caused by neutron irradiation. The twinning behavior of irradiated vanadium is investigated in tensile tests conducted at liquid nitrogen temperature. (J.R.D.)

48499 (ORNL-4420, pp 131-68) MECHANICAL PROPERTIES RESEARCH AND LMFBR CLADDING AND STRUCTURAL MATERIALS DEVELOPMENT. Weir, J. R. Jr.; McCoy, H. E. Jr. (Oak Ridge National Lab., Tenn.).

Specimens of standard types 316 and 316L stainless steel and Ti-modified (about 0.2% Ti) types 304, 304L, 316, and 316L stainless steel were irradiated to a fast fluence of 1.4×10^{21} neutrons/cm^2 (>1 MeV) over a period of 4000 hr at temperatures of 350, 450, and 550°C. The postirradiation yield stresses measured at the respective irradiation temperatures were generally 10 to 30% higher than that of the unirradiated control sample; the Ti-modified type 304L stainless steel was an exception and showed much larger increases. The fracture strains were reduced at all temperatures by irradiation, and the magnitude of the reduction increased with increasing test temperature. The Ti-modified steels had higher fracture strains than the standard steels. The mechanical properties of Incoloy 800 vary appreciably with thermal treatments as well as irradiation. Electron microscopy has revealed that the amount and distribution of the precipitates vary with annealing and aging. The precipitates have been identified as $Cr_{23}C_6$ and titanium sulfide. Samples of Ti-modified type 304 stainless steel were given various heat treatments and then injected with 20 ppM He in a cyclotron. A heat treatment that produced precipitates in both grain boundaries and matrix gave the optimum rupture life; the optimum fracture strains were produced in material that had been recrystallized at 925°C. Several samples of Ni 270 and type 304 stainless steel were irradiated in the EBR-II to fast fluences of 10^{18} to 10^{20} neutrons/cm^2 over a wide range of temperatures. Transmission electron microscopy was used to observe the defects produced and the nature of the damage in these two materials was compared. The defects produced were observed in a type 304L stainless steel shroud tube where the peak fluence was 5×10^{22} neutrons/cm^2 (>0.1 MeV). A sample of V removed from EBR-II was examined after irradiation to a fast fluence of 1.7×10^{22} neutrons/cm^2 (>0.1 MeV) at 630°C. The measured void density was 5.2×10^{15} voids/cm^3, and the computed swelling was 0.57%. Postirradiation annealing from 600 to 900°C revealed little change in structure at 650°C and complete annealing at 900°C. Statistical analysis of aging results on the Ti-modified Hastelloy N revealed that a preaging anneal of 1 hr at 1260°C gave results that contradicted those obtained for other anneals. This may be due to the grain growth that occurs during this anneal or the solution of additional solutes. The key to a modified Hastelloy N seems to be the correct precipitate structure. The desired structure seems to result when the MC type of carbide is formed, and it appears that Ti, Zr, Hf, and Nb favor the formation of this type. (auth)

48500 THERMAL EXPANSION OF A LINEAR CHAIN UNDER STRESS APPLICATION TO CREEP UNDER IRRADIATION. Quere, Y.; Ponsoye, J. (Centre d'Etudes Nucleaires, Fontenay-aux-Roses, France). Radiat. Eff., 1: 141-4(July 1969). (In French).

Variations of thermal expansion coefficient $\Delta\alpha$ of a linear atomic row under stress are evaluated. Variations of Young's modulus with temperature are deduced. A reasonable agreement, on this point, with experimental measurements indicates that at least the sign obtained for $\Delta\alpha$ subsists qualitatively for a 3-dimensional crystal. It is then shown that, for a crystal irradiated under stress with high-energy particles, this variation $\Delta\alpha$ may lead to a negative contribution to creep. (auth)

48501 SWELLING OF FISSILE MATERIALS IN NONUNIFORM TEMPERATURE AND NEUTRON FIELDS. Likhachev, Yu. I.; Zvonarev, V. P. At. Energ. (USSR), 27: 196-200(Sept. 1969). (In Russian).

Swelling of simple form fuel cores (cylinder, sphere, plate) in nonuniform temperature and neutron fields is considered. The total cumulative fuel core strain for the core operating

time is defined. This problem is important first of all for the calculation of the fast reactor fuel elements. (auth)

Ceramics and Cermets

Refer also to abstracts 47423 and 48315–48317.

48502 (ORNL–4420, pp 3-39) DEVELOPMENT OF FAST-REACTOR OXIDE FUELS. Patriarca, P.; Lotts, A. L. (Oak Ridge National Lab., Tenn.).

Two fuel pins containing Sphere-Pac fuels were fabricated for irradiation in the Oak Ridge Research Reactor (ORR) instrumented capsules and one capsule was fabricated for irradiation of Sphere-Pac fuels in the Engineering Test Reactor (ETR). Efforts during the quarter were devoted to the fabrication of two capsules for transient testing of sol-gel fuels in the Transient Reactor Test Facility (TREAT). The program for fabrication of pellets with 85 and 91% of theoretical density for the two TREAT experiments was continued. The gravimetric and NITROX methods of analyzing the ratio of O to metal were compared. The average of four batches loaded into the Experimental Breeder Reactor-II (EBR-II) fuel rods was 1.987 for gravimetric and 1.985 for the NITROX method. Trial calculations to determine the important variables in the calculation of burnup were initiated. In the continuing studies of the plastic deformation of UO_2, results showed that UO_2 specimens prepared from ammonium diuranate, although of higher density (97 rather than 92%), are more susceptible to deformation than specimens prepared from sol-gel. Further studies were conducted to determine the relationship between lattice parameter, composition, and O activity of $(U,Pu)O_2$ and particularly to determine the effect of thermal gradients on composition. The ratio of O to metal obtained from measurements of lattice parameters of a UO_2 rod that had been placed in a thermal gradient of 1820 to 950°C ranged from 2.002 to 1.998, respectively. Irradiation of two ETR uninstrumented capsules, which contain Sphere-Pac $(U,Pu)O_2$, continued normally. One of these, operating at a linear heat rate of about 16.5 kW/ft, achieved a burnup level of about 7% fissions per initial metal atom (FIMA). One ETR capsule, which operated at a linear heat rate of 18 kW/ft, achieved its target burnup level of 5% FIMA and was removed from the reactor. The second ORR instrumented capsule containing Sphere-Pac $(U,Pu)O_2$ fuel was placed into operation. Preliminary analysis of the data from the second capsule, which is now being operated, shows that the conductivity of the Sphere-Pac fuel is essentially the same as that of pellet fuels of comparable smear density; this supports the principal conclusion from the operation of the first instrumented capsule. Five encapsulated fuel rods, all containing sol-gel-derived $(U_{0.8},Pu_{0.2})O_2$ Sphere-Pac fuel, were incorporated into subassembly X050 of the EBR-II and placed under irradiation on February 27, 1969. It was shown that predictions of a fuel model developed in the laboratory are in excellent agreement with experimentally determined burnups for $(U,Pu)O_2$ fuel pins and with measured and calculated temperatures for the first instrumented capsule assembly. The FMØDEL code for fuel performance was refined to include an analysis for fuel restructuring and temperature distribution, an analysis for elastic and plastic creep deformation, a calculation for release of fission gas and gas pressure, and an empirical description of intrinsic swelling of the cladding due to the condensation of vacancies formed by irradiation damage. (auth)

48503 (ORNL–4420, pp 40-70) DEVELOPMENT OF HIGH-PERFORMANCE LMFBR FUELS. Patriarca, P.; Scott, J. L. (Oak Ridge National Lab., Tenn.).

A 500-g batch of $U^{15}N$ pellets was successfully fabricated. These pellets will be used as a standard in a study of the effects of n,p and n,α reactions with ^{14}N on the performance of $U^{14}N$. The rate-controlling step in the conversion of UC_2 to U(C,N) was identified to be the diffusion of C from the UC_2–U(C,N) interface to the nearest free-C site. The activation energy for the diffusion of C under these conditions is 77.7 ± 3.7 kcal/mole. Thus, the reaction rate is enhanced by a uniform, fine distribution of free C throughout the microstructure. Studies on the removal of free C from structures consisting of U(C,N) plus C showed that H_2 alone is ineffective. The presence of small amounts of water or CO greatly accelerates the removal of C. The solubility of N_2 in UC_2 was found to be a maximum of 8 at. % at 1700°C at a N_2 pressure of 400 torr. In studies to assess the compatibility of V with C and nitrides, the complete mutual solubility of VC and UN was observed. The lattice parameters of solid solutions showed negative deviations from Vegard's law. Two new phases, UVC_2 and UVN_2, were discovered. Their crystal structures were deduced to be isomorphous with $UMoC_2$. (auth)

48504 (ORNL–4420, pp 222-40) DEVELOPMENT OF FUEL ELEMENT FABRICATION. Adamson, G. M. Jr. (Oak Ridge National Lab., Tenn.).

Studies of blistering, are being conducted using cyclotron bombardment as a method of adding known quantities of H to Al compacts. No blisters formed on compacts annealed at temperatures up to 550°C after 0.33 ppM H was added. Burned U_3O_8 was shown to be compatible with Alcoa 101 Al powder and type 6061 Al cladding, as evidenced by the absence of a reaction, at fabrication temperatures up to 600°C. Nickel coatings deposited electrolessly on plates of types 6061 and 2219 Al were characterized both before and after heat treatment. In both cases, heating to 500°C caused serious spalling, but heating at 300°C caused no visible changes. The coating on both alloys resisted the thermal shock of being quenched in water from gradually increasing temperatures. No spalling was evident on the type 2219 Al samples after quenching from temperatures up to 475°C or on type 6061 after quenching from 350°C. The thickness of the coatings made it difficult to obtain reproducible results for hardness. While the coating became somewhat more hard after the 300°C treatment, it was still ductile. As expected, the width of the interface between the materials increased during heat treatment, the increase for type 6061 Al being greater than that for type 2219 Al. Work has continued on the use of radiography and film densitometry to measure inhomogeneities in dispersion fuel plates. It has been shown that the density of a film may be varied by the length of the film, the orientation of the axis of the x-ray tube, and the kind of safelights used. When fuel plates for the Advanced Test Reactor (ATR) were inspected for fuel in homogeneity by both densitometry and by x-ray attenuation, the latter method was much quicker and revealed many inhomogeneities missed by radiography. Testing of miniature fuel plates in the ETR was interrupted by a malfunction of the loop. The samples were not harmed and will be returned to the reactor as soon as possible. The program for future irradiations was agreed upon, and fabrication of samples was started. New samples containing sol-gel and burned U_3O_8 have been prepared as mini-type test plates for insertion later in the year. To determine if the increase in He release during irradiation would cause difficulties in an advanced HFIR core, samples were prepared and characterized containing up to 2.0 wt % B_4C for irradiation. (auth)

48505 ADVANCES IN STRUCTURAL COMPOSITES. 12th National Symposium and Exhibit, Anaheim, California, October 10–12, 1967. Society of Aerospace Material and Process Engineering Proceedings, Volume 12. Azusa, Calif., Society of Aerospace Material Process Engineers, 1967. 459p. (CONF-671084). North Hollywood, Calif., Western Periodicals Company.

Sixty-six papers were presented at the conference. A separate abstract was prepared for each of nine papers. Papers for which no abstracts were prepared are concerned with advances in composites, insulation, deep water submersibles, industrial applications, new reinforcements, advanced structures, processing methods for composites, composite design, and applications in armor. (J.R.D.)

For abstracts of individual papers see: 48380, 48448, 48506, 48523, 48524, and 48551–48554.

Corrosion and Erosion

Refer also to abstract 48327.

48506 CORROSION OF BORON-METAL COMPOSITES. Porter, M. C.; Wolff, E. G. (Avco Corp., Lowell, Mass.). Sci. Advan. Mater. Process Eng. Proc., 12: AC.14.1-16(1967).

From 12th National SAMPE Symposium on Advances in Structural Composites, Anaheim, Calif. See CONF-671084.

Four systems, aluminum/boron, aluminum alloy 40E/boron, copper/boron, and nickel/boron were tested in corrosive environments including solutions of nickel chloride, sodium chloride, ferric chloride, and aluminum sulfate. The rates of corrosion under varying conditions of temperature and aeration were measured for these systems. In addition, the effect of corrosion on the mechanical properties of aluminum/boron composites was evaluated. In general, the presence of boron resulted in only slight increases in the corrosion rates measured. (auth)

Preparation and Fabrication

Refer also to abstracts 47438, 47588, 47683, 48372, 48551, and 49564.

48507 (GEAP-10032) POWER REACTOR HIGH PERFORMANCE UO_2 PROGRAM: FABRICATION OF CENTERMELT ASSEMBLIES. Ikeuye, D. T.; Lees, E. A.; Ogawa, S. Y. (General Electric Co., San Jose, Calif. Nuclear Fuels Dept.). June 1969. Contract AT(04-3)-189. 34p. (EURAEC–2122). Dep. CFSTI.

Work Performed under United States–Euratom Joint Research and Development Program.

Fabrication of six fuel assemblies for irradiation testing in the Consumers Big Rock Point reactor is described. Two of the assemblies were referred to as the intermediate performance fuel assemblies and were designed for incipient melting of the UO_2 at rated power conditions. There are 64 fuel rods arranged in an 8×8 array in each assembly. The fuel rods in one assembly contain UO_2 pellets, while the other assembly contains vibratory-compacted UO_2. The remaining four assemblies were referred to as the advanced performance fuel assemblies. The fuel rods in these assemblies were designed for moderate melting of the UO_2 at rated power conditions. There are 49 rods in an assembly, arranged in a 7×7 array. The fuel rods in two assemblies contained sintered UO_2 pellets and those in the other two assemblies contained vibratory-compacted powder. (auth)

48508 (MLM–1569) CATION EXCHANGE METHOD FOR PREPARING $^{238}PuO_2$ MICROPARTICLES. Silver, G. L. (Mound Lab., Miamisburg, Ohio). Aug. 15, 1969. Contract AT-33-1-GEN-53. 29p. Dep. CFSTI.

A method was developed for preparing metal oxide microparticles in gram quantities by ignition of metal-loading resins. Satisfactory results were obtained only with cation exchange resins. The parameters for controlling the characteristics such as particle size, hardness, and density were determined. Plutonium dioxide microparticles prepared by the method described could serve as fuel materials in isotopic heat sources. Sintering of the loaded resins in the quartz apparatus used gave satisfactory particles that were often perfect microspheres. Metal oxide microparticles of several other elements, including thorium and zirconium, were also prepared by this process. (auth)

48509 (WARD–3791-36) URANIUM–PLUTONIUM CARBIDE DEVELOPMENT. Quarterly Progress Report for the Period Ending March 31, 1969. (Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div.). May 1969. Contract AT(30-1)-3791. 68p. Dep. CFSTI.

Activities in a research program are reported on (U,Pu)C directed toward the development of sodium-bonded fuel elements the intents of which are to maximize heat transfer between fuel and cladding and to provide expansion space for fuel swelling to minimize fuel and mechanical interaction between cladding. Investigation of the major effects of fuel production process variables continued. The effects of varying binders, milling time, sieve size, purge gas flow rate, and sintering temperature rise rate were studied. Co-fabrication of EBR-II fuel pellets continued during the period. Working with the results obtained from the experimental program, modifications were made to the fabrication process, and immediate success was noted. Routine analytical chemistry evaluation of potential EBR-II fuel and experimental batches continued. Immersion density determinations and metallography were conducted. All equipment in the characterization line performed satisfactorily, and only minor servicing was required. Five irradiation pins were successfully completed using a combination of vibratory and centrifugal-force bonding treatments. Additional sodium purity samples were analyzed to determine the fabrication procedures which influence oxygen contamination in sodium. Three GETR capsules were transported to the LASL hot cells for post-irradiation examination. The capsules have been x-radiographed the full length of the fueled regions at two orientations 90° to each other. Preliminary review of the radiographs indicates the depleted UC insulator pellets are cracked similarly to the fuel pellets. Two capsules, WZX and W8X were loaded into EBR-II. They form part of subassembly X050 in grid position 4C2. Because of the phase-out of the project, a revised irradiation program was prepared. (J.R.D.)

48510 (Y–1688) PREPARATION OF HIGH-PURITY BORON NITRIDE POWDER. Schmitt, C. R.; Edwards, R. K. (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). Oct. 6, 1969. Contract W-7405-eng-26. 56p. Dep. CFSTI.

Laboratory studies were made on the preparation of high-purity boron nitride powder by the reaction of a mixture of boric oxide and tricalcium orthophosphate with ammonia at 900°C. Many experimental parameters were studied, namely: reaction temperature, time at the reaction temperature, purity and dryness of gaseous ammonia, chemical removal of the calcium filler compound by dilute hydrochloric acid treatment, purification of boron nitride product by removal of unreacted boric oxide by alcohol extraction, low-temperature steam volatilization, and renitridation at 1,400°C. Nitrogen analysis of laboratory-prepared boron nitride powder showed that 98.4% of the theoretical nitrogen content of boron nitride was obtained, and x-ray diffraction analysis identified hexagonal boron nitride as the major constituent with no other detectable intermediate or minor constituents. Various types of laboratory-prepared and commercial boron nitride powders were also characterized by electron photomicrographs. (auth)

48511 INVESTIGATION OF RECRYSTALLIZATION IN SINTERING POWDERS OF NIOBIUM AND TITANIUM CARBIDES. Samsonov, G. V.; Bozhko, S. A. (Inst. of Problems of Material Studies, Kiev). Porosh. Met., Akad. Nauk Ukr. SSR, No. 7, 30-5 (July 1969). (In Russian).

When sintering powdered niobium and titanium carbides in the regions of their homogeneity above 1600°C accumulative recrystallization takes place. The change in the constants of grain growth rate and activation energy of the accumulative recrystallization is connected with the change in electronic structure of the carbides in the homogeneity region. (auth)

48512 DISPERSION HARDENING OF ZIRCONIUM WITH YTTRIA. (to Atomic Energy of Canada Ltd.). British Patent 1,163,643. Sept. 10, 1969. Priority date June 21, 1966, Canada.

A process for preparation of Y_2O_3–Zr cermet is described. Powdered zirconium hydride is mixed with powdered yttrium oxide and pressure sintered to decompose the hydride and produce a dispersion of yttrium oxide particles in a void-free Zr metal matrix. (J.R.D.)

48513 PREPARATION OF THIN BORON FILMS. Olempska, Zofia; Piotrowski, Romuald (Inst. of Physics, Warsaw). Przegl. Elektron., 9: 528-33(Nov. 1968). (In Polish).

Preparation of thin boron films on silicon backing was achieved by hydrogen reduction of boron chloride. A device was constructed for precise control of the reagent mixtures. Kinetics of boron precipitation on the plate were evaluated. Thin films with the lowest crystalline defects were obtained at 1000°C with determined reagent composition and flow rate. (R.V.J.)

48514 EXPERIMENTAL STUDY OF FABRICATION OF FLAT-PLATE MULTIPLE CERMET FUEL ELEMENTS. de Souza Santos, Tharcisio Damy; Capocchi, Jose Deodoro Trani; Cintra, Sebastiao Hermano Leite (Instituto de Energia Atomica, Sao Paulo, Brazil). Metalurgia (Sao Paulo), 24: 295-9(Apr. 1968). (In Portuguese).

Flat-plate fuel elements were made containing 4 cermets of 45% U_3O_8 and 55% Al. U_3O_8 powder of 325 mesh was obtained by calcination of $(NH_4)_2UO_7$ and Al powder of 100 mesh was imported. The powder mixture was placed in a rectangular demountable container of exact dimensions and precompacted to $32 \times 45 \times 6.10$ mm plates under 80-ton pressure. The plates were presintered in an electric furnace by heating for 60 min to 600°C in an Ar atmosphere. The assembly for colamination of the plates consisted of a frame of proper dimension and two cover plates. The inside of all pieces was covered with a layer of 1100 Al. After cleaning with NaOH and HNO_3 the plates were welded in an electric arc of W electrodes in an Ar atmosphere by depositing 8 beads of solder on each side. By heating the plates in an electric furnace for 40 min at 600°C the lamination was completed. The composite plate was cold rolled until it reached the exact thickness. The multiple cermets were first subjected to a blistering test by keeping them 1 hour at 450°C and then radiographically examining by a medical x-ray apparatus. The blistering test was satisfactory and the x-ray pictures showed no irregularity. (tr-auth)

48515 HIGH DENSITY UO_2 PELLETS. Haydt, Heliton Motta; de Freitas, Clauer Trench; Capocchi, Jose Deodoro Trani (Instituto de Energia Atomica, Sao Paulo, Brazil). Metalurgia (Sao Paulo), 24: 139-44(Feb. 1968). (In Portuguese).

For study of the effects of various production methods, more than 7,000 UO_2 pellets were tested with the aim of obtaining pellets of highest density. UO_2 was made by reduction of UO_3 and U_3O_8 in H_2 atmospheres. The granules obtained were converted in an electric grinding machine into powder suitable for compaction. To make pellets of sufficient consistency and prevent cracking the powder was impregnated with small amounts of alcoholic camphor solution and zinc stearate. The final pellets were obtained with and without precompaction by heating in electric ovens to 1450°C in Ar or N_2 atmosphere. For temperatures up to 1800°C an H_2 atmosphere was used. The effects of precompaction, pressure, temperature, sintering time, and oven atmosphere were tested. Precompaction had little effect on density, which increased with pressure and sintering time. Final density of pellets was 9.8 g/cm^3, in agreement with values reported in literature. (tr-auth)

48516 EXPERIMENTAL RESULTS ON THE KINETICS OF THE GROWTH OF TUNGSTEN CARBIDE CRYSTALS IN THE PRESENCE OF COBALT. Coster, Michel; Deschanvres, Alfred (Laboratoire de Chimie Minerale Industrielle, Calvados, France). Compt. Rend., Ser. C, 269: 221-3(July 21, 1969). (In French).

The isothermal growth of tungsten carbide in the presence of

cobalt was studied as a function of time and composition in the temperature range 1300 to 1600°C. The rule for crystal growth is in the form of $t^{\frac{1}{3}}$ without apparent deformation of the size distribution curve. The activation energy for the growth process is 85 ± 20 kcal. The continuity of the WC phase varies significantly as a function of the composition. (tr-auth)

48517 PREPARATION OF HIGH DENSITY URANIUM MONOCARBIDE (UC) PELLETS BY REACTION SINTERING OF MIXTURE OF URANIUM DICARBIDE AND URANIUM METAL POWDERS. Moorthy, V. K.; Zope, B. D. (Bhabha Atomic Research Centre, Bombay). Trans. Indian Inst. Metals, 22: No. 1, 25-30 (Mar. 1969).

Sintered pellets of uranium carbide are required as a fuel in nuclear reactors. They can be prepared by conventional methods by sintering UC powders at relatively high temperatures (about 1800°C) where certain amount of U_2C_3 and UC_2 are also formed. Attempts were made to prepare single phase UC pellets of high density by reaction sintering of pellets made from stoichiometric mixture of uranium dicarbide and uranium metal powder. It was found that the formation of monocarbide starts at 1000°C and is completed at 1300°C. This process has the additional advantage that high density can be attained even in the green state. Pellets of a density of about 97% theoretical were obtained by pressing the stoichiometric mixture at 800 to 1200°C. The conversion to UC was brought to completion by subsequent vacuum sintering at about 1400°C. (auth)

48518 FABRICATION OF URANIUM CARBIDE. Kantan, S. K.; Rao, N. K.; Varma, B. P. (Bhabha Atomic Research Centre, Bombay). Trans. Indian Inst. Metals, 21: 51-6(Dec. 4, 1968).

Uranium carbide is a promising fuel for sodium cooled reactor systems. Results of development work on fabrication of uranium carbide shapes are described. Hypostoichiometric, homogeneous UC-slugs, 15 mm dia, 100 mm long, with carbon content in the range of 4.6 to 4.8 wt % have been cast by the arc melting and casting process. A suitable, vacuum arc furnace with flexible electrode stringer rod was indigenously fabricated for this purpose. The feed stock to the melting furnace was either pre-reacted UC-granules or synthesized carbide buttons. A mixture of UO_2 and graphite powders was compacted, granulated and sintered in an induction furnace, under vacuum at 1950°C for 1 hour to obtain the reacted granules. The buttons weighing 500 g were prepared by synthesizing elemental uranium and graphite in a button melting graphite hearth, with graphite electrode, in an arc furnace. The arc melting and casting of the slugs were done under a dynamic atmosphere of argon in a graphite hearth with graphite electrode, either by withdrawal method or by tilt pouring. In the withdrawal method the graphite plug at the bottom of the graphite hearth was withdrawn and molten material cast under gravity, in the cavity left behind. In the latter process, the charge was melted in a rocking graphite hearth and was cast in an attached graphite mould by tilt-pouring. Metallographic method of carbon determination in the slugs was found to be a quick and reliable method. Dry grinding of the cast slugs was possible with silicon-carbide wheels. The cutting of the slugs necessitated use of a diamond wheel. Handling of rather massive uranium carbide did not pose any special problem and clean slugs could be stored in a desiccator with silica gel for months without any visible surface deterioration. (auth)

48519 PREPARATION AND SUPERCONDUCTIVITY OF GERMANIUM-STABILIZED $Sc_{13}C_{10}$. Krikorian, N. H. (Los Alamos Scientific Lab., N. Mex.); Giorgi, A. L.; Szklarz, E. G.; Krupka, M. C.; Matthias, B. T. J. Less-Common Metals, 19: 253-7(Nov. 1969).

A new body-centered cubic scandium carbide phase having the approximate composition $Sc_{13}C_{10}$ has been prepared by high-temperature annealing of arc-melted samples containing small amounts of germanium. The lattice parameters of this new phase varied from a_0 = 8.514 to 8.530 Å suggesting a range of homogeneity. All compositions were found to be superconducting with the transition temperature ranging from 7.0 to 8.5°K. Similar measurements on the previously reported Sc_4C_3 bcc phase showed no superconducting transition for measurements down to 1°K. (auth)

48520 II KONFERENCJA METALURGII PROSZKOW, 20-23 IX. 1967. CZESC I. (Second Conference on Powder Metallurgy, 20-23 September 1967. Volume I). Stolarz, S.; Missol, W.; Zolkowski, W.; Kurzeja, J.; Cyunczyk, A. (eds.). Krakow, Zakladzie Graficznym Politechniki Slaskiej w Gliwicach, 1967. 447p. (In several languages). (CONF-670988-(Vol.1)).

A total of 29 papers were presented at the meeting. A separate abstract was prepared for each of 4 papers. The remaining 25 papers were not within the scope of NSA. (G.M.C.)

For abstracts of individual papers see: 48443, 48444, 48522, and 48546.

48521 DIFFUSION WELDING OF METAL CERAMIC METALS. Burykina, A. L. pp 478-94 of II Konferencja Metalurgii Proszkow, 20-23 IX. 1967. Czesc II. Stolarz, S.; Missol, W.; Zolkowski, W.; Kurzeja, J.; Cyunczky, A. (eds.). Krakow, Zakladzie Graficznym Politechniki Slaskiej w Gliwicach, 1967. (In Russian).

From 2nd Conference on Powder Metallurgy, Krakow, Poland. See CONF-670988-(Vol.2).

Optimum conditions were found for diffusion welding of Zr, Nb, and Ta carbides with Nb, Ta, Mo, and W, and self-diffusion welding of TiC, Mo_2C, and WC. Diffusion welding of TiC and WC with Mo and W metals was also investigated. All studies were carried out in a vacuum at 1200 to 2000°C. (R.V.J.)

48522 PRODUCTION OF HIGH-PURITY CARBIDES. Koso-lapova, T. Ya. pp 216-26 of II Konferencja Metalurgii Proszkow, 20-23 IX. 1967. Czesc I. Stolarz, S.; Missol, W.; Zolkowski, W.; Kurzeja, J.; Cyunczyk, A. (eds.). Krakow, Zakladzie Graficznym Politechniki Slaskiej w Gliwicach, 1967. (In Russian).

From 2nd Conference on Powder Metallurgy, Krakow, Poland. See CONF-670988-(Vol.1).

A design is given of an installation for carbide production by precipitation from a suspended gaseous phase. Curves were constructed for the rate of zirconium and niobium carbide precipitation as a function of the hydrogen consumption and temperature. Monocrystals of ZrC and NbC with dimensions of 0.1 to 0.8 mm were obtained by precipitation from the powder phase. (R.V.J.)

48523 ADVANCES IN THE DEVELOPMENT OF RPG. Williams, Richard M. Sci. Advan. Mater. Process Eng. Proc., 12: AC.13.1-20(1967).

From 12th National SAMPE Symposium on Advances in Structural Composites, Anaheim, Calif. See CONF-671084.

RPG is a new family of carbon composite materials produced through the infiltration of carbon or graphite fibers with deposits of pyrolytic carbon or pyrolytic carbon-metal alloys exhibiting high strength to weight ratios. Manufacturing techniques and process controls that have been developed to produce these high strength materials are described. The composites are tailor-made to provide a wide range of thermal and mechanical properties. The range extends from low density composites of 8 to 10 lb/ft^3 having insulating properties better than the "c" direction of pyrolytic graphite to materials with densities as high as 115 to 120 lb/ft^3 having very high mechanical strength properties and exhibiting excellent ablation resistance in arc tests. Material has also been produced containing both high and low densities, forming a rigid, one-piece structure. A good application for this type structure would be a thrust chamber or rocket nozzle insert having a high density inner surface and, through a narrow transition area, a low density thermal barrier on the outside. It is possible to produce parts of considerable size with cross section areas several inches in thickness and having uniform densities within ±5%. Two processes have been developed for providing RPG with oxidation resistance. These systems involve the use of protective coatings of pyrolytic boron nitride and silicon carbide. (J.R.D.)

48524 AN INVESTIGATION OF DIFFUSION BONDED BORON-ALUMINUM COMPOSITES. Stuhrke, William F. (Air Force Materials Lab., Wright-Patterson AFB, Ohio). Sci. Advan. Mater. Process Eng. Proc., 12: AC.17.1-11(1967).

From 12th National SAMPE Symposium on Advances in Structural Composites, Anaheim, Calif. See CONF-671084.

The mechanical behavior of diffusion bonded boron-aluminum composite materials is interpreted in terms of four stages. A rationalization of the experimentally observed synergistic modulus values is presented, based on the postulated development of an internal hydrostatic triaxial stress state in the matrix. A justification for possible strengths of boron-aluminum composites in excess of 200 ksi at about 30 volume percent filament is presented. (auth)

48525 NEODYMIUM MOLYBDATES. Mokhosoev, M. V.; Get'man, E. I. Izv. Akad. Nauk SSSR, Neorg. Mater., 5: 908-13(May 1969). (In Russian).

X-ray-phase and differential-thermal analysis were used for studying the mechanism of neodymium molybdate formation. It is shown that synthesis of neodymium oxymolybdates follows in several stages with intermediate products containing mean neodymium molybdate and also less basic neodymium molybdates. The existence of neodymium molybdates, not previously described, composed of $Nd_2O_3 \cdot 4\ MoO_3$, $Nd_2O_3 \cdot 6\ MoO_3$, and $7\ Nd_2O_3 \cdot 8\ MoO_3$ was established. (tr-auth)

Properties Evaluations

Refer also to abstracts 47442, 47708, 48330, 48331, 48333–48335, 48386, 48387, 48400, 48417, 48433, 48509, 49003, 49005, and 49602.

48526 (DP-1201) MASS SPECTROMETRIC–THERMOGRAVIMETRIC TECHNIQUE FOR EVALUATING THE GAS RELEASE POTENTIAL OF SINTERED THORIA. Chastagner, Philippe (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). Sept. 1969. Contract AT(07-2)-1. 9p. Dep. CFSTI.

A mass spectrometric—thermogravimetric technique coupled with electrochemical moisture determinations is described for the characterization of sintered thoria. The data obtained can be used to evaluate the gas release potential of thoria during reactor irradiation to produce ^{233}U. (auth)

48527 (IS-T-333) IONIC DOMAIN FOR YTTRIA DOPED THORIA AT LOW OXYGEN POTENTIALS. Hardaway III, John Benjamin (Ames Lab., Iowa). Aug. 1969. Contract W-7405-eng-82. 41p. Dep. CFSTI.

Thesis.

The emf method has been used to determine the low-oxygen potential limit for essentially pure anionic conduction in $Th_{0.85}Y_{0.15}O_{1.925}$. The temperature range covered in the investigation was from 775 to 1000°C. The results show that the oxygen transference number is greater than or equal to 0.99 when $\log P_{O_2} \geq -6.5\ 10^4/T°K + 29$. (auth)

48528 (ORNL-4420, pp 123-30) FAST-NEUTRON IRRADIATION EFFECTS ON ELECTRICAL INSULATORS. Keilholtz, G. W.; Dyslin, D. A.; Moore, R. E.; Robertson, H. E. (Oak Ridge National Lab., Tenn.).

Metallographic examinations of four commercial polycrystalline alumina products irradiated in a short-term ETR assembly were completed. Specimens irradiated at 580 to 1070°C that did not have separation at the grain boundaries expanded in volume linearly with fast fluence. The expansion increased from 1.9 to 3.0% over the fast-fluence range 1.3 to 2.8×10^{21} neutrons/cm^2. Values for specimens with separation at grain boundaries were considerably higher. There was a reduced expansion and no separation at grain boundaries found in specimens irradiated at 1100°C. At very much higher temperatures, however, separation at the grain boundaries became very severe. In general, the severity of this separation increases with increasing volume expansion of the grains and with increasing grain size. No definite correlation could be found between the degree of separation and gross fracturing of specimens, which appears to be related to the presence of impurities or unknown factors in the fabrication. (auth)

48529 SILICONATED PYROLYTIC GRAPHITE. PART 4. ELECTRICAL RESISTIVITY. Yajima, Seishi; Hirai, Toshio (Tohoku Univ., Sendai). J. Mater. Sci., 4: 692-8(Aug. 1969).

Investigations were made on the electrical resistivity ρ of siliconated pyrolytic graphite (PG(Si), 0.02 to 4 wt % silicon) prepared by pyrolysis of a mixture of propane gas and silicon tetrachloride vapour at various deposition temperatures, total gas pressures, and partial pressures of silicon tetrachloride vapour. With increase in the partial pressure of silicon tetrachloride, ρ, decreased and ρ_c increased. The electrical anisotropy (ρ_c/ρ_a) of PG(Si) is two orders of magnitude higher than that of PG, at deposition temperatures between 1600 and 1700°C and a total gas pressure of 50 torr. Effects of the silicon content, density and structural features on the resistivities and the anisotropy are discussed. The anisotropy is closely related to the preferred orientation, and high values of ρ_c/ρ_a induced by discontinuity in the stacking of crystallites are lowered in silicon-rich PG(Si) by the presence of SiC between the crystallites. (auth)

48530 INVESTIGATION OF GRAPHITE AND PYROGRAPHITE REACTIONS WITH TITANIUM, NIOBIUM, MOLYBDENUM, AND TUNGSTEN DISILICIDES. Evtushok, T. M.; Burykina, A. L. (Inst. of Problems in Material Studies, Kiev). Porosh. Met., Akad. Nauk Ukr. SSR, No. 7, 78-85(July 1969). (In Russian).

Reactions of $TiSi_2$, $NbSi_2$, $MoSi_2$, and WSi_2 with graphite and pyrographite were investigated in vacuum of $5 \cdot 10^{-5}$ mm Hg at 1200 to 2000°C for 1 to 5 hrs. As a result of the reactions of $TiSi_2$, $MoSi_2$, and WSi_2 with graphite and pyrographite, the ternary phases $Me_xSi_yC_z$ and SiC were formed and $NbSi_2$ reacted forming NbC and SiC. Thermodynamic calculations carried out were in agreement with the experimental data. (auth)

48531 ELASTIC BEHAVIOR OF ARC-CAST ZIRCONIUM CARBIDE–GRAPHITE ALLOYS. Carnahan, R. D.; Janowski, K. R.; Rossi, R. C. (Aerospace Corp., El Segundo, Calif.). J. Amer. Ceram. Soc., 52: 475-7(Sept. 21, 1969).

The Young's and shear moduli of arc-cast zirconium carbide-graphite alloys were measured as a function of graphite content and were found to depend strongly on the microstructure of the alloys. Attempts to fit several theoretical analyses to the data were unsuccessful. The simplified physical models from which these analyses were derived limit their usefulness in predicting elastic behavior for materials having complex microstructures. (auth)

48532 ELASTIC PROPERTIES OF POLYCRYSTALLINE YTTRIUM OXIDE, HOLMIUM OXIDE, AND ERBIUM OXIDE: HIGH-TEMPERATURE MEASUREMENTS. Manning, W. R.; Hunter, O. Jr. (Ames Lab., Iowa). J. Amer. Ceram. Soc., 52: 492-6(Sept. 21, 1969).

The Young's and shear moduli of polycrystalline yttrium oxide, holmium oxide, and erbium oxide were determined from room temperature to 1000°C using the sonic resonance technique. The bulk modulus and Poisson's ratio were computed as functions of temperature for each oxide. The Young's, shear, and bulk moduli decreased linearly with increasing temperature, whereas Poisson's ratio remained constant. The first and second Grüneisen constants, γ and δ, were calculated from the bulk modulus data and shown to be virtually independent of temperature. The Soga-Anderson equation adequately described the bulk modulus data for each oxide. (auth)

48533 DIFFUSION OF ^{233}U IN UO_2. Reimann, D. K.; Lundy, T. S. (Oak Ridge National Lab., Tenn.). J. Amer. Ceram. Soc., 52: 511-12(Sept. 21, 1969).

An investigation was conducted which was aimed at finding the true lattice diffusion coefficients associated with ^{235}U diffusion in pure UO_2 single crystals and in UO_2 polycrystals having large but varying grain size. Results of a carefully controlled experiment are presented. It is felt that the results disagree with those obtained in previous investigations because the influence of grain boundary diffusion was underestimated or altogether neglected in previous work. (J.R.D.)

48534 LOW-TEMPERATURE THERMAL CONDUCTIVITY OF URANIUM NITRIDE. Radosevich, Lee G.; Williams, Wendell S. (Univ. of Illinois, Urbana). Contract AT(11-1)-1198. J. Amer. Ceram. Soc., 52: 514(Sept. 21, 1969).

The thermal conductivity of polycrystalline UN was measured at 2 to 85°K. The data are presented graphically with the calculated value of thermal conductivity and the derived value of lattice thermal conductivity. An analysis of the data is included. (J.R.D.)

48535 MICROHARDNESS OF TiO_2–Nb_2O_5 SOLID SOLUTIONS. Tien, T. Y.; Rosen, J. J.; Bigelow, W. C.; Sanvordenker, V. (Univ. of Michigan, Ann Arbor). J. Amer. Ceram. Soc., 52: 520(Sept. 21, 1969).

Samples of solid solutions of Nb_2O_5 in TiO_2 having the ratio Ti : Nb = 88 : 22 were prepared in an average grain size of 30 μm. Results of hardness measurement at 600 to 1400°C using a Reichert microhardness tester are presented graphically. Comments concerning the results are included. (J.R.D.)

48536 MECHANICAL AND PHYSICAL PROPERTIES OF SOME WC–Co CEMENTED CARBIDES. 2nd REPORT. ROTATING BENDING FATIGUE TESTS OF WC–Co CEMENTED CARBIDES. Hara, A.; Yazu, S. Sumitomo Denki, No. 100, 136-43(July 1969). (In Japanese).

Results of fatigue tests on several WC–Co cemented carbides are presented. It is generally recognized that the data from fatigue tests on hard materials are widely scattered. Consequently, it is desirable to represent them statistically. The most probable S–N equations were used to compute the S–N–P (P: probability of fracture) curves for each WC–Co cemented carbide. The observation of the fracture surface, measurement of the coercive force and study of x-ray diffraction were made in order to study the fatigue mechanism, the results of which are discussed briefly. (auth)

48537 DISPERSION STRENGTHENED MOLYBDENUM AND MOLYBDENUM-BASE ALLOYS. White, J. E. (Aerospace Corp., El Segundo, Calif.); Barr, R. Q. Met. Soc. Conf., 41: 541-55(1967).

From Symposium on Physical Metallurgy of Refractory Metals, French Lick, Ind. See CONF-651025-(Vol.1)).

An evaluation of dispersion strengthening of Mo is presented. Results show that an addition of 2.5% ThO_2 markedly improves the elevated temperature tensile strength of molybdenum from 2500 to 3500°F. A very pronounced resistance to recrystallization and grain growth in this temperature range is also afforded. Additions of less than 1% elemental Ti and Zr powders to molybdenum billets hot-pressed under an argon atmosphere provide a marked improvement in both fabricability and elevated temperature tensile elongation. This is apparently the result of Ti and Zr removing oxygen by forming stable oxide inclusions. Ti and Zr additions to Mo alloys containing a ThO_2 dispersion result in degradation of the ThO_2 distribution resulting from a solid state reaction occurring primarily between Zr and ThO_2. The resulting dispersed phase distribution then affords no improvement in elevated temper-

ature mechanical properties relative to TZM alloys of the same matrix composition. (auth)

48538 ELASTIC PROPERTIES AND THERMAL EXPANSION OF NIOBIUM MONOCARBIDE TO HIGH TEMPERATURES. Brenton, R. F.; Saunders, C. R.; Kempter, C. P. (Los Alamos Scientific Lab., N. Mex.). J. Less-Common Metals, 19: 273-8 (Nov. 1969).

The temperature dependence of Young's modulus of polycrystalline $NbC_{0.969}$, with a density of 95.8% of theoretical, follows Wachtman's equation and may be expressed as $E = 4.6039 \times 10^{12} - 5.7289 \times 10^{8}\ T \exp(-200.5/T)$ dynes/cm^2 from 285 to 2173°K. The temperature dependence of the shear modulus is linear and may be expressed as $G = 1.9286 \times 10^{12} - 2.4848 \times 10^{8}\ T$ dynes/cm^2 from 284 to 2173°K. Above 2173°K the moduli decrease rapidly, possibly due to viscous grain boundary slip. This temperature corresponds to 0.56 of the absolute melting point maximum for niobium monocarbide. The dilatometric linear thermal expansion was found to be 2.04% from 17 to 2447°C. (auth)

48539 THE EFFECTS OF ZrO_2 PURITY AND OF THE METHOD OF STABILIZATION ON SOME PROPERTIES OF Zr CERAMICS. Demonis, I. M.; Kalliga, G. P. Tr. Mosk. Khim.-Technol. Inst., No. 50, 185-90(1966). (In Russian).

The effects of ZrO_2 purity and the conditions of stabilization in ceramic products have been studied. Tests were made with industrially pure and very pure ZrO_2. (The ZrO_2 content in the very pure variety was 99.5%. In the pure variety, as much as 2.5% HfO_2 was present). CaO was used as a stabilizer. It was found that preliminary stabilization of the very pure ZrO_2 led to increased density of the ceramic product and, at the same time, to lower specific electrical resistance at 1000°C (by a factor of 1.5 to 2). This stabilization also led to higher bending strength at higher temperatures (1000 to 1200°C) than found in ceramics obtained when stabilization and sintering were combined. The degree of stabilization, sinterability, and several other useful properties remained practically unchanged when pure ZrO_2 was used. The minimal values of specific electrical resistance were found in material in which 15% CaO was used as the stabilizer, regardless of the method of stabilization or the purity of the initial ZrO_2. (JPRS)

48540 CALCULATION OF THE HEAT OF SUBLIMATION OF ZIRCONIUM TRIBROMIDE. Tsirelnikov, V. I. (Univ. de Chile, Santiago). J. Less-Common Metals, 19: 287-8(Nov. 1969).

Data in the literature on the thermal disproportionation of zirconium tribromide were obtained by measuring the temperature dependence of the equilibrium pressure of zirconium tetrabromide over various samples of zirconium tribromide in spiral quartz manometers. The considerable deviation of the experimental pressures of $ZrBr_4$ from pressures calculated assuming the validity of the gas laws can be explained by the reactions: $2ZrBr_{3(s)} \rightleftharpoons ZrBr_{2(s)} + ZrBr_{4(g)}$ and $ZrBr_{2(s)} + ZrBr_{4(g)} \rightleftharpoons 2ZrBr_{3(g)}$. From this hypothesis total vapor pressures for the system were calculated for different temperatures; these calculated pressures agreed satisfactorily with the experimental pressures. Based on the above reactions the heat of sublimation of $ZrBr_3$ at 750°K was calculated to be 76.4 ± 6.4 kcal/mole. (G.M.C.)

48541 MEASUREMENTS OF THE VAPOR PRESSURES OF THE OXIDES OF LANTHANIDES BETWEEN 2000 AND 2400°C. Benezech, Gilbert; Foex, Marc (CNRS, Pyrenees-Orientales, France). Compt. Rend., Ser. C, 268: 2315-18(June 30, 1969). (In French).

Apparatus for the measurement of vapor pressures by transpiration was adapted to a solar furnace and used to measure the vapor pressures of lanthanide oxides. The partial vapor pressures measured are graphed and correspond to those found previously by Shchukarev and Semenov, with the exception of the oxides of Eu and Yb. These oxides, especially Yb, have much lower values. The slopes of the lines obtained are much less than that found previously. The calculation of the heats of reaction using the present experimental values gave heats of vaporization slightly lower for La and Nd than previous studies. Beginning with Sm the results agree with those of other methods. (J.S.R.)

48542 LOW-CYCLE FATIGUE OF TD-NICKEL AT 1800°F. Leverant, G. R.; Sullivan, C. P. (Pratt and Whitney Aircraft, Middletown, Conn.). Trans. Met. Soc. AIME, 245: 2035-9(Sept. 1969).

Recrystallized TD-nickel (Ni-2ThO_2) in both coated and uncoated conditions was fatigued at 1800°F at total strain ranges varying from 0.2 to 0.75%. The fatigue life of uncoated material, N_f, was related to the total strain range, $\Delta\epsilon_T$, by $(2N_f)^{0.21}\Delta\epsilon_T = 0.014$. A duplex Al–Cr pack coating increased the fatigue life by about a factor of two. The cracks that led to failure in both coated and uncoated material were initiated at the outer surface, indicating that the mechanical properties of the surface layers were important in determining fatigue life. Crack propagation and subsurface crack initiation in the TD-nickel occurred preferentially at grain boundaries with cavitation at thoria particle-matrix interfaces an integral part of the grain boundary fracture process. The importance of both the grain morphology developed during thermomechanical processing of TD-nickel and the distribution of thoria particle sizes to fatigue resistance are discussed. (auth)

48543 HIGH TEMPERATURE INTERNAL FRICTION OF TD NICKEL. Sovik, J. H.; Clauer, A. H.; Maringer, R. E.; Wilcox, B. A. (Battelle Labs., Columbus, Ohio). Trans. Met. Soc. AIME, 245: 1943-6(Sept. 1969).

Internal friction measurements from 25 to 1100°C have been made on specimens machined from TD nickel bar. The use of miniature torsional pendulum specimens allowed damping measurements to be made on specimens whose axes were parallel to the original bar axis, at 45° to the bar axis, and at 90° to the bar axis. There was a marked difference in damping with varying specimen orientation, and this was related to the pronounced microstructural anisotropy of this material. Varying the microstructure by cold working plus recrystallization annealing also greatly affected the damping behavior. Recrystallization essentially removed the broad peak found at 400 to 650°C in as-received TD nickel, and in addition greatly lowered the background damping. (auth)

48544 II KONFERENCJA METALURGII PROSZKOW, 20–23 IX. 1967. CZESC II. (Second Conference on Powder Metallurgy, 20–23 September 1967. Volume II). Stolarz, S.; Missol, W.; Zolkowski, W.; Kurzeja, J.; Cyunczyk, A. (eds.). Krakow, Zakladzie Graficznym Politechniki Slaskiej w Gliwicach, 1967. 314p. (In several languages). (CONF-670988-(Vol.2)).

A total of 21 papers are included. A separate abstract was prepared for each of 5 papers. The remaining 16 papers were not within the scope of NSA. (G.M.C.)

For abstracts of individual papers see: 48371, 48521, 48545, 48547, and 48548.

48545 HIGH-TEMPERATURE ELECTRIC INSULATORS AND CERAMICS. Samsonov, G. V.; Dubrovik, T. V.; Kazakov, K. V. pp 460-77 of II Konferenzja Metalurgii Proszkow, 20–23 IX. 1967. Czesc II. Stolarz, S.; Missol, W.; Zolkowski, W.; Kurzeja, J.; Cyunczyk, A. (eds.). Krakow, Zakladzie Graficznym Politechniki Slaskiej w Gliwicach, 1967. (In Russian).

From 2nd Conference on Powder Metallurgy, Krakow, Poland. See CONF-670988-(Vol.2).

Insulating properties and crystal structure of boron carbonitride were studied. Tabulated data showed that boron carbonitride was stable in the air up to 1500 to 1700°C, in hydrogen and carbon monoxide up to 2000 to 2500°C, and in nitrogen up to 3000°C. Experiments indicated that BN–Si_3N_4 was stable in molten borox at 950°C. When BN–Si_3N_4, Si_3N_4–SiC, TiC, and ZrC were immersed in molten zinc for 120 to 172 hr, BN–Si_3N_3 had the lowest losses per unit weight. (R.V.J.)

48546 PRODUCTION AND PROPERTIES OF WC-SINGLE CRYSTALS. Ruediger, O. pp 196-215 of II Konferencja Metalurgii Proszkow, 20–23 IX. 1967. Czesc I. Stolarz, S.; Missol, W.; Zolkowski, W.; Kurzeja, J.; Cyunczyk, A. (eds.). Krakow, Zakladzie Graficznym Politechniki Slaskiej w Gliwicach, 1967. (In German).

From 2nd Conference on Powder Metallurgy, Krakow, Poland. See CONF-670988-(Vol.1).

Single crystals of WC were grown in a metal bath containing 40% Co, 3 to 5% C, and about 55% W in carbon or Al_2O_3 crucibles by means of the Bridgman method. The maximum edge length was 7 mm, and the thickness was 2.5 mm. The carbon content was stoichiometric, and the oxygen content was 0.01 to 0.05%. The lattice constants at room temperature were a = 2.8998 to 2.9007 kX and C = 2.8292 to 2.8309 kX. The solubility of Co in WC at 1600°C was < 0.05 wt %. The electron-beam microprobe showed Co inclusions of different sizes at a number of crystal surfaces. No detectable impurities could be found in the WC crystal lattice itself. The microhardness of the basal surface was 2000 kp/mm^2, while it varied from 1300 to 1800 kp/mm on the prism surface. The thermal expansion coefficient along the (100) plane was 6.7×10^{-6} per °C, and along the (001) plane it was 4.9×10^{-6} per °C between 20 and 400 °C. The time for complete wetting of a WC single crystal depended on the crystallographic surface; for example, the prism plane at about 1480°C was completely wetted in about 33 minutes. (TTT).

48547 INVESTIGATIONS OF HIGH-TEMPERATURE MATERIALS BASED ON BORIDES. Kotsch, Heinz. pp 711-23 of II Konferencja Metalurgii Proszkow, 20–23 IX. 1967. Czesc II.

Stolarz, S.; Missol, W.; Zolkowski, W.; Kurzeja, J.; Cyunczyk, A. (eds.). Krakow, Zakladzie Graficznym Politechniki Slaskiej w Gliwicach, 1967. (In German).

From 2nd Conference on Powder Metallurgy, Krakow, Poland. See CONF-670988-(Vol.2).

Materials for uses at temperatures above 1000°C require high temperature stability and resistance to oxidation. Materials in the B-Br-Cr-Mo and B-Cr-Mo-Ti systems were investigated as having the most favorable possibilities for these uses. The investigations included determining the most advantageous combination of components, the structure of these alloys, and the effects of C and Si additives and impurities on the characteristics of the materials obtained. The results showed that: the measured creep strengths of the materials obtained were greater than the values in previously published literature; the characteristics of materials in these systems with a range of quantity of alloying ingredients could be determined; and slight impurities in the C or Si contained in Cr_3C_2 or $MoSi_2$ additives do not always cause undesirable results. (L.C.L.)

48548 POWDER MOBILITY IN VIBRO-COMPACTED FUEL ELEMENTS. Van Asbroeck, Ph.; Luyten, G.; Bairiot, H. pp 734-49 of II Konferencja Metalurgii Proszkow, 20-23 IX. 1967. Czesc II. Stolarz, S.; Missol, W.; Zolkowski, W.; Kurzeja, J.; Cyunczyk, A. (eds.). Krakow, Zakladzie Graficznym Politechniki Slaskiej w Gliwicach, 1967.

From 2nd Conference on Powder Metallurgy, Krakow, Poland. See CONF-670988-(Vol.2).

The fabrication of fuel elements by densification of UO_2 and PuO_2 powders by sound vibrations is briefly described. The fuel elements must have a high density and a homogeneous plutonium and density distribution. The different grain sizes must be piled up in the fuel element as regular as possible; this is dependent on the mobility of the particles and their imbrication inside the cladding. The mobility of the ceramic powders during the filling of the cladding tube and during and following compaction was experimentally investigated. The grain size of the powders and the fabrication method influenced the mobility of the fissile ceramic powders. (G.M.C.)

48549 PROCHNOST' I DEFORMATSIYA MATERIALOV V NERAVNOMERNYKH FIZICHESKIKH POLYAKH. VYPUSK II. (Strength and Deformation of Materials in Irregular Physical Fields. Issue 2). Fridman, Ya. B. (ed.). Moscow, Atomizdat, 1968. 276p.

Twelve articles on the stability of heat resisting materials used in piping, reactor vessels, and other industrial applications are presented. The stability of deformed materials undergoing thermal aging was examined. Studies were made of accumulated damage in the materials for nonhomogenous conditions of temperature, pressure, and submergence. Cyclic creep and the swelling of fuel elements and fissionable materials, including UO_2, BeO, Al_2O_3, and MgO, under irregular temperatures and neutron fields were analyzed. Tests on the thermal aging of metals were made using microspecimens. The application of thermodynamic methods for resolving temperature problems related to the elastic stability of materials was discussed. (tr-auth)

48550 SPECIFIC HEAT OF UN, UC, AND UO_2. Affortit, C. (Centre d'Etudes Nucleaires, Fontenay-aus-Roses, France). High Temp. High Pressures, 1: 27-33(1969). (In French).

The specific heat of sintered specimens of UN, UC, and UO_2 was measured up to temperatures close to their melting points. A steep increase of the specific heat of UC and UO_2 when approaching their melting points was recorded. (auth) (UK)

48551 FILAMENT-WOUND BORON IN ELECTRODEPOSITED ALUMINUM MATRIX. Abrams, Edwin F. (General Technologies Corp., Reston, Va.); Kinna, Marlin. Sci. Advan. Mater. Process Eng. Proc., 12: AC.16.1-16(1967).

From 12th National SAMPE Symposium on Advances in Structural Composites, Anaheim, Calif. See CONF-671084.

The effort was directed toward the demonstration of the superiority of composites of high-modulus filament in a metal matrix over conventional materials for rocket motor case application relative to specific modulus and specific strength. The composites were fabricated of hoop-wound boron filament and the matrix of aluminum was electrodeposited from an ethereal plating solution. These materials were evaluated individually and also in the form of monofilament composites, NOL ring composites, and finally as short, full-scale-diameter motor case sections. (auth)

48552 THE DEVELOPMENT AND PROPERTIES OF CAST BORON/ALUMINUM COMPOSITES. Hill, Russell J. (Avco Corp., Lowell, Mass.); DeLai, A. Joseph; Rogen, Neil E.; Stuhrke, William F. Sci. Advan. Mater. Process Eng. Proc., 12: AC.18.1-8(1967).

From 12th National SAMPE Symposium on Advances in Structural Composites, Anaheim, Calif. See CONF-671084.

A description is given of a method used to fabricate boron filament reinforced aluminum alloy matrix composite materials. The method is a modified casting technique which is capable of producing complex shapes. The composite is not restricted in terms of boron filament distribution with respect to aligned or randomly oriented, continuous or discontinuous, and high or low volume percents of filament. The tensile properties and modes of fracture as a function of temperature for a range of various types of composites are presented and discussed. (auth)

48553 THE EFFECT OF HEAT TREATMENT ON THE PHYSICAL PROPERTIES OF SOME BORON-ALUMINUM ALLOY MATRIX COMPOSITES. Sumner, E. V. (Harvey Engineering Labs., Torrance, Calif.). Sci. Advan. Mater. Process Eng. Proc., 12: AC.19.1-8(1967).

From 12th National SAMPE Symposium on Advances in Structural Composites, Anaheim, Calif. See CONF-671084.

Data on the effects of stress relieving, solution heat treating, and solution heat treating with aging on the ultimate tensile strength of boron-aluminum alloy matrix composites are tabulated and discussed. (auth)

48554 CROSSPLIED FILAMENTARY METAL-MATRIX COMPOSITES. Toy, A.; Dickerson, E. O. (North American Aviation, Inc., Los Angeles). Sci. Advan. Mater. Process Eng. Proc., 12: D.6.1-21(1967).

From 12th National SAMPE Symposium on Advances in Structural Composites, Anaheim, Calif. See CONF-671084.

Composites with filaments oriented at various crossply angles may be desirable for structures under combined loading conditions. Shear strength of metal matrix filamentary composites can be doubled and the shear modulus increased by 50 percent by crossplying. This, however, is accompanied by corresponding reductions in axial properties. Analytical and experimental results showing influences of filament content, filament spacing, filament properties, matrix properties, filament-matrix bonded strength, and the effects of nonlinear stress strain characteristics are presented. Good correlation has been demonstrated between analytical predictions and experimental data using composites of boron and beryllium filament reinforced aluminum. Analysis of tested specimens indicated that the fracture modes are tensile filament failure for composites with uniaxially alined filaments in the direction of the applied stress. Shear fracture generally occurs in a direction parallel to the filament for intermediate crossply angles. (auth)

48555 SOME CHEMICAL PROPERTIES OF ZIRCONIUM NITRIDE. Lyutaya, M. D.; Kulik, O. P. Izv. Akad. Nauk SSSR, Neorg. Mater., 5: 885-8(May 1969). (In Russian).

The stability of powdered zirconium nitride in dilute and concentrated hydrochloric acid was studied. The rate of nitride decomposition increased with increasing acid concentration, nitrogen content, and reaction temperature. The stability of saturated solutions of zirconium nitride in nitric and sulfuric acids and in oxidizers was studied. The saturated solutions of zirconium nitride were decomposed by hydrochloric acid, by concentrated sulfuric and nitric acids, and by oxidizers, and resulted in the production of gaseous nitrogen. (tr-auth)

Structure and Phase Studies

Refer also to abstracts 47434, 47438, 47659, and 48479.

48556 (EUR-4291) STRUCTURAL INHOMOGENEITIES IN PYROCARBON COATINGS DEPOSITED IN THE FLUIDIZED BED. Pellegrini, G. (European Atomic Energy Community, Petten (Netherlands). Joint Nuclear Research Center). Mar. 25, 1969. 24p. Dep. CFSTI (U. S. Sales Only).

An appreciable inhomogeneity in the structure of a 100 μ thick flat pyrocarbon coating deposited in a fluidized bed at constant temperature and gas composition has been found as a function of the thickness. The preferred orientation and the crystallite size increase continuously with the coating thickness, while the interlayer spacing decreases. Emphasis is placed on measurements of the preferred orientation at various coating levels and on the precise x-ray technique and sample preparation necessary to achieve a reliable and reproducible measurement of this quantity. A calculation of thermal expansion coefficients from the preferred orientation data shows that a difference of more than 15% in thermal expansion exists between the innermost and outermost layers of the coating. It is concluded that the differential strains which are generated by heating and under irradiation at high temperatures may seriously endanger the mechanical integrity of the coating. (auth)

48557 (IA–1189) PHASE TRANSFORMATIONS IN REFRACTORY OXIDE FILMS UNDER ELECTRON-BEAM HEATING. Aladjem, A.; Brandon, D. G.; Yahalom, J.; Zahavi, J. (Israel Atomic Energy Commission, Tel Aviv). May 1969. 32p. Dep. CFSTI (U. S. Sales Only).

Refractory oxide films were prepared by anodic oxidation of pure aluminum, titanium, niobium, tantalum, and tungsten and examined by direct transmission electron microscopy. Phase transformations were induced in the film by electron beam heating in the microscope, and the crystalline phases formed were identified. With the exception of titanium and zirconium oxides, the films were amorphous in the as-formed state. The defect structure of the crystallized phases and the mode of crystallization were different for each oxide and specific for the given oxide. (auth)

48558 (IS–2133) GROUP IV AND V TRANSITION METAL RICH CHALCONIDE X-RAY POWDER DIFFRACTION DATA. Franzen, H. F.; Smeggil, J. G.; Conard, B. R. (Ames Lab., Iowa). Aug. 1969. Contract W-7405-eng-82. 18p. Dep. CFSTI.

Guinier powder diffraction data are tabulated for the following metal-rich chalconide compounds: Ti_2S, Ti_2Se, Zr_2S, Zr_2Se, HF_2S, HF_2Se, HfSe, $Nb_{21}S_8$, Nb_2Se, Ta_2S, and Ta_6S. (auth)

48559 (JUL–596-RG) CALCULATION AND DESIGN OF THERMODYNAMIC PHASE DIAGRAM WITH THE HELP OF AN ELECTRONIC COMPUTER. Gat, Uri; Hoerbe, R. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Reaktorentwicklung). May 1969. 51p. (In German). Dep. CFSTI (U. S. Sales Only).

A program for calculating and drawing thermodynamic phase diagrams of a three element system (a metal and two metalloids) is described. The program retrieves the necessary thermodynamic data (enthalpies, entropies, etc.) from a data bank. It calculates the equilibrium constants of any two compounds of the system, and selects the valid phase boundaries. These boundary lines can be drawn by a plotter, or alternatively, points of the lines are printed by their coordinate values. There are three types of diagrams: "boundary diagrams," in which the metal and only one of the metalloids take part; isotherms; and partial isobars in which the partial pressure of one of the metalloids is kept constant. The partial pressure, or optionally a gas combination representing this partial pressure is drawn on the ordinate. The abscissa describes either the temperature (1000/T) or in the case of isotherms the partial pressure of the other metalloid. (auth)

48560 (KFK–845, pp 5.1-11) QUANTITATIVE ETCH PREPARATION AND QUANTITATIVE STRUCTURE ANALYSIS OF CERMETS. Jesse, Andreas (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material- und Festkoeperforschung). (In German).

Examples of the quantitative etch preparation, the quantitative material structure analysis, and the stereometric analysis are discussed on the basis of quantimet measurements. The examples given include the study of polishing conditions on the etch grade of a UO_2–Mo cermet, concentration profile of precipitates in a UN–V–10 Ti compatibility probe, and concentration distribution of UO_2 in UO_2–Cu cermets. (tr-auth)

48561 INVESTIGATION OF THE TERNARY SYSTEM Mo–W–B. Kharitonov, V. I.; Shamrai, F. I. (Inst. of Metallurgy, Moscow). Porosh. Met., Akad. Nauk Ukr. SSR, No. 7, 60–4(July 1969). (In Russian).

The compounds $MoB_{\sim 12}$ and $WB_{\sim 12}$ were identified and the existence of a continuous series of solid solutions $(Mo,W)B_{\sim 12}$ was established in the Mo–W–B system. The projection of the liquidus surface on the plane of a concentration triangle of the Mo–W–B system and isothermal section of the system at 1100°C were plotted. (auth)

48562 SILICONATED PYROLYTIC GRAPHITE. PART 3. STRUCTURAL FEATURES. Yajima, Seishi; Hirai, Toshio (Tohoku Univ., Sendai). J. Mater. Sci., 4: 685–91(Aug. 1969).

The structural features of several samples of siliconated pyrolytic graphite (0.02 to 4 wt % silicon) prepared at various deposition temperatures, total gas pressures and partial pressures of silicon tetrachloride vapour were examined by x-ray diffraction. The structural features investigated included interlayer spacing, ordering, intercrystallite porosity, preferred orientation and crystallite size. These features are affected by the preparation conditions. By the addition of silicon tetrachloride vapour, the ordering and the crystallite size of the graphite matrix are developed, the preferred orientation improved and the porosity diminished. The effects of the addition of silicon tetrachloride on the structural features are marked at high total gas pressures, at high partial pressures of silicon tetrachloride vapour and in the medium temperature range of 1600 to 1700°C. (auth) (UK)

48563 THE STRUCTURE OF ZrO_2 WITH Sc ADDITIVES. Lidorenko, N. S.; Kagan, A. S.; Bykovskaya, L. A.; Efimovskaya, T. V.; Lyutsareva, L. A.; Chizhik, S. P.; Shumanova, S. P. Dokl. Akad. Nauk SSSR, 187: 791-2(Aug. 1, 1969). (In Russian).

The structure of ZrO_2 with Sc was studied and the electric conductivity of ZrO_2 as a function of the molar content of Sc was analyzed. Experiments were carried out with prepared specimens of ZrO_2 and Sc_2O_3 annealed at 1750°C followed by aging at 200°C and 1000°C. Data obtained showed that the structure of ZrO_2 with increased content of Sc_2O_3 slowly approached a cubic lattice which eventually resulted in formation of chemical compound close to $5ZrO_2 \cdot Sc_2O_3$, with the improved conductivity at the optimum concentration with 9 mole % Sc_2O_3 when the structure was practically cubic and the amount of the second phase was at its minimum. (R.V.J.)

48564 ON FORMATION OF THE NEW PHASES IN THE SYSTEMS STRONTIUM OXIDE–SAMARIUM, GADOLINIUM, AND DYSPROSIUM OXIDES. Lopato, L. M.; Kushchevs'kii, A. E. (Inst. of Problems in Study of Materials, Kiev). Dopov. Akad. Nauk Ukr. RSR, Ser. B, No. 7, 635–7(July 1969). (In Ukrainian).

New phases of 2 : 1 and 4 : 1 composition are syntheized in the systems Sm_2O_3–SrO, Gd_2O_3–SrO, and Dy_2O_3–SrO. The phases of 4 : 1 composition could have regions of homogeneity. The temperature limits of stability and some roentgen characteristics of the synthesized phases are determined. (auth)

48565 ON THE FIRST VANADIUM–OXYGEN SUBOXIDE PHASE (VO_x) BY MEANS OF ELECTRON MICROSCOPY, ELECTRON DIFFRACTION, AND X-RAY DIFFRACTION. Cambini, M. (CCR–EURATOM, Petten, Netherlands); Heerschap, M.; Gevers, R. Mater. Res. Bull., 4: 633–42(Sept. 1969).

Electron microscopic observations of the first suboxide phase formed in the vanadium–oxygen system are given. The VO_x suboxide ($VO_{0.06}$–$VO_{0.1}$) is found by means of electron diffraction to be tetragonal (c/a = 0.97 – 0.96), the x-ray data being consistent with this result. The twinned structure of this phase and the direct resolution of a long period superstructure are presented. (auth)

48566 NEW HEXAGONAL-TYPE OXIDE OF NIOBIUM. Nakayama, T.; Osaka, T.; Kitada, A. (Waseda Univ., Tokyo). J. Less-Common Metals, 19: 291-3(Nov. 1969).

A hexagonal-type compound, thought to be an oxide, has been found on the surface of niobium in the early stages of heating in a $CuCl_2$ aqueous solution. Transmission and reflection electron diffraction studies indicated the presence of a new niobium compound with a hexagonal lattice. The unit cell dimensions were calculated from the reflections. It was concluded that the new hexagonal compound was probably an oxide, but it was not certain whether it was composed of Nb_2O_3, polymorphs of NbO_2, or other oxides. (G.M.C.)

48567 PHASE RELATIONSHIPS IN THE HIGH-LIME PART OF THE SYSTEM CaO–Nb_2O_5–SiO_2. Jongejan, A.; Wilkins, A. L. (Dept. of Energy, Mines, and Resources, Ottawa). J. Less-Common Metals, 19: 203-8(Nov. 1969).

Liquidus temperatures have been determined in the high-lime part of the system CaO–Nb_2O_5–SiO_2 using the Griffin–Telin hot-stage microscope equipped with an iridium–rhodium type of thermocouple. The liquidus fields of the compounds $3CaO \cdot SiO_2$, $4CaO \cdot Nb_2O_5$, $5CaO \cdot Nb_2O_5$, and $11CaO \cdot 2Nb_2O_5$, which involved temperatures that could not be reached with apparatus used in previous studies, have been outlined. (auth)

48568 RE-EXAMINATION OF THE SYSTEM Nb_2O_5–TiO_2 AT LIQUIDUS TEMPERATURES. Jongejan, A.; Wilkins, A. L. (Dept. of Energy, Mines, and Resources, Ottawa). J. Less-Common Metals, 19: 185-91(Nov. 1969).

The liquidus curve for the system Nb_2O_5–TiO_2 has been determined by means of the Griffin–Telin hot-stage microscope. The shape of the curve confirmed the existence of the compounds $5Nb_2O_5 \cdot 2TiO_2$ and $Nb_2O_5 \cdot TiO_2$, which melted congruently at 1488 and 1498°C, respectively. The existence of a compound with the composition $3Nb_2O_5 \cdot 2TiO_2$ was also indicated. It melted congruently at 1486°C. The results of x-ray diffraction analysis of samples quenched from 1350 and 1450°C, combined with those of differential thermal analysis, suggest that the compound $3Nb_2O_5 \cdot 2TiO_2$ was stable only above 1425°C. The melting temperature of Nb_2O_5 has been determined to be 1507°C. The previously published value of 1483°C appears to be a transition temperature between two forms of Nb_2O_5. (auth)

48569 REACTIONS IN THE SOLID STATE OF THE SYSTEM BETWEEN CeO_2 AND ALKALINE-EARTH METAL OXIDES: ELECTRICAL CONDUCTIVITY AND STRUCTURE OF THE PHASES PRESENT. Danelon Mastromonaco, Maria; Barbariol, Iginio; Cocco, Antonio (Univ., Trieste, Italy). Ann. Chim. (Rome), 59: 465–87(May 1969). (In Italian).

An extensive examination of the literature on the stability of the various phases, their structure and electric conductivity, of sintered mixtures of CeO_2 and CaO, MgO, SrO, or BaO revealed some discrepancies, which were the starting point for this investigation. The results confirmed the existence of solid solutions, whose limits between 900 and 1700°C are presented only for CaO and SrO in CeO_2. For these solid solutions with fluorite-type cubic structure the variations of the lattice parameters with composition were determined, as well as their anion-deficient structures. For the temperature range 900 to 1700°C the existence of the compounds $SrCeO_3$, Sr_2CeO_4, and $BaCeO_3$ was confirmed, and evidence is provided that no other cerates exist. The structures of these compounds were studied by the powder x-ray diffraction method with the aid of a computer (IBM 7044). The electrical conductivities and their variations with temperature in the range 900 to 1200°C were also determined for the solid solutions in CeO_2 and the strontium cerates. A critical comparison is made between the experimental results obtained here and those reported previously. (BBB)

48570 CERTAIN FEATURES OF HIGH-TEMPERATURE PHASE TRANSITIONS IN RARE-EARTH METAL DICARBIDES. Paderno, Yu. B.; Yupko, V. L.; Makarenko, G. N. Izv. Akad. Nauk SSSR, Neorg. Mater., 5: 889-93(May 1969). (In Russian).

The temperature dependence of specific electric conductivity, thermal emf, and relative elongation of rare earth dicarbides was determined. The abnormal behavior of TmC_2 during phase transitions was revealed. The magnitude of Debye temperatures, the mean square amplitudes of elastic oscillations of structural complexes, and the coefficient of thermal expansion of rare earth dicarbides were estimated. Data were obtained on electric and galvomagnetic properties of SmC_2 at room temperature. (tr-auth)

Radiation Effects

Refer also to abstracts 48494, 48501, 48509, and 49564.

48571 (EIR-146) PLUTONIUM FUEL MATERIAL PROGRAM. Annual Report, 1968. (Eidgenoessisches Institut fuer Reaktorforschung, Wuerenlingen (Switzerland)). Apr. 1969. 97p. (In German). Dep.

A program for irradiation experiments on plutonium oxide materials for thermal reactors was developed. The preparation of the uranium–plutonium carbides, including the steps of UO_2 sol preparation, UO_2–C mixed sol preparation, gelling process, carbothermal reduction, and quality control, is described. The microscopic and x-ray analysis techniques used for the study of the ceramic materials are discussed. The preliminary results obtained in the irradiation of uranium–plutonium oxide are reported. The processing for the irradiation of the carbides is discussed. The post-irradiation techniques of autoradiography, gamma scanning, and burn-up determination are described. Preliminary results are given. The special laboratory equipment used in this program is described. (J.S.R.)

48572 (GEAP-4926) PERFORMANCE ANALYSIS OF HIGH POWER DENSITY PROGRAM FUEL RODS IRRADIATED IN VBWR-TERMINAL EXAMINATION. Pashos, T. J.; Duncan, R. N.; Arlt, W. H.; Mathay, P. W. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). Sept. 1968. Contract AT(04-3)-361. 136p. Dep. CFSTI.

Work performed on fuel rods irradiated to demonstrate high power density operation in a boiling water reactor (BWR) and to provide fabrication development and irradiation experience with fuel having low fabrication cost potential is described. The program involved irradiation of approximately 800 UO_2 fuel rods clad with either cold-worked or annealed commercial grade Type-304 stainless steel. Some of the rods contained UO_2 pellets, the standard fabrication process. Others were fabricated by various powder compaction processes that showed potential for lower fabrication costs. Both freestanding and thin-wall clad designs were used. The leading fuel rods had attained average and peak exposures of 9,910 and 16,850 MWd/t, respectively, at the termination of irradiations. The most significant result of the irradiation program was the revelation of the unexpected susceptibility of unsensitized stainless steel cladding to intergranular cracking in a water-cooled reactor environment. Cladding cracking occurred at peak rod exposures ranging from 6,050 MWd/t for thin-wall, collapsed cladding to 16,850 MWd/t for freestanding cladding having an initial pellet-to-clad cold gap of up to 8 mils. There were 27 failed rods out of the 643 pellet rods irradiated, and 3 failed rods out of 154 compacted powder rods irradiated. The post-irradiation examination of failed and nonfailed fuel rods included investigation of the cause and nature of the cladding failures, gamma scans, diameter profile, length measurements, fission gas release measurements, and measurement of changes in cladding mechanical properties during irradiation. (auth)

48573 (GEAP-5702) ZIRCALOY-CLAD UO_2 FUEL ROD EVALUATION PROGRAM. Quarterly Progress Report No. 4, August–October 1968. Megerth, F. H. (General Electric Co., San Jose, Calif. Nuclear Fuels Dept.). Nov. 1968. Contract AT(04-3)-189. 33p. Dep. CFSTI.

To demonstrate the capability of Zircaloy-clad fuel to achieve average burnups of at least 6×10^{20} fissions/cc (20,000 MWd/tU) and to take advantage of the available lead time in achieving these burnup targets, 98 of the higher exposure Fuel Cycle Program rods were incorporated in a special assembly, designated SA-1, and inserted in the Dresden reactor for additional irradiation. The assembly consists of two 7-by-7 subassemblies stacked one on top of the other in a channel of standard dimensions for the Dresden reactor. Assembly SA-1 continued to operate during the report period. Additional metallographic examinations were performed on sections of some of the ten fuel rods that were removed from the assembly earlier. It was noted that some increase in corrosion, but apparently no appreciable mechanical wear, occurred at or near SA-1 spacer spring contact points. One such point showed a layer of ZrO_2 0.14 cm across and 70 to 100 microns thick. Elsewhere the external oxide consisted of a 10-micron film with intermittent patches 40 to 50 microns thick. Increased corrosion was noted in and around a 0.005- to 0.008-cm-deep groove that had been worn in the cladding of a rod by a spacer wire during VBWR operation. Blister-like protrusions that were grouped in the form of circumferential rings on a rod surface appeared in sectional view as areas of greater than normal corrosion. Patches of ZrO_2 which were considerably more extensive and thicker (83 microns) than normal were noted where these "rough rings" were pronounced. The cause of the rings is unknown. The ZrO_2 films on the internal cladding surfaces averaged from less than 1 to a maximum of 5 microns among the two transverse and three longitudinal metallography specimens. The UO_2 in three specimens was examined. The grain size in two was uniform; the third showed a small amount of central grain growth. Gas samples collected from two fuel rods were analyzed for carbon dioxide by chromatography. The CO_2 content in each case was 0.11 volume percent. (auth)

48574 (ORNL-4420, pp 71-6) FISSION-GAS RELEASE AND PHYSICAL PROPERTIES OF FUEL MATERIALS DURING IRRADIATION. Sisman, O. (Oak Ridge National Lab., Tenn.).

A new experiment using a hollow cylinder of UO_2 has been constructed to measure thermal diffusivity during irradiation. Spheroids of $(U_{0.75},Pu_{0.25})O_2$ fuel are being irradiated. The gas release shows the same characteristics as cylinders of the same material irradiated previously. It was found that the temperature at which swelling begins is a linear function of burnup. Metallographic examination of UN specimens irradiated in an Al_2O_3 holder shows the specimens reacted chemically with the holder to form a UO_2 compound by removing O from the Al_2O_3. (auth)

48575 (ORNL-4420, pp 119-22) BEHAVIOR OF REFRACTORY MATERIALS UNDER IRRADIATION. Keilholtz, G. W.; Dyslin, D. A.; Moore, R. E.; Robertson, H. E. (Oak Ridge National Lab., Tenn.).

The following experiments were initiated which will conclude the investigation of fast-neutron effects on carbides of refractory metals (Ti, Zr, Ta, Nb, and W): short-term, low-temperature irradiations, out-of-reactor postirradiation annealing, and electron microscopy of irradiated carbides. The purpose of these experiments was to obtain additional data for constructing a model for neutron damage. Preliminary results from the annealing experiments indicate that the fractional volume shrinkage during annealing is the same for each of the five types of carbides regardless of the magnitude of the original volume expansion that occurred during irradiation. Components of a high-temperature (1000°C) assembly for irradiating depleted UN, UC, and U (50 mole % C, N) were fabricated. This experiment is designed for evaluating the effects on nitride fuels of helium gas generated through the $^{14}N(n,\alpha)^{11}B$ fast-neutron reaction. Planning and engineering design were started on an EBR-II assembly for irradiation of Ta metal, TaC, and possibly other materials with large neutron-absorption cross sections. The objective of this task is to provide information needed for developing materials for control of the reactivity of fast reactors. (auth)

48576 (UNC-5244) FAST REACTOR MIXED-CARBIDE FUEL ELEMENT DEVELOPMENT PROGRAM. Seventh Quarterly Progress Report, January–March 1969. (United Nuclear Corp., Elmsford, N. Y. Research and Engineering Center). July 7, 1969. Contract AT(30-1)-3415. 44p. Dep. CFSTI.

Activities in programs aimed at development of mixed carbide

fuels for LMFBR are summarized. Clad profilometry data from three rods containing high-density helium-bonded mixed carbide pellets irradiated to 40,000 Mwd/t at 28 kW/ft were analyzed indicating that the fuel swells in the range of <2.0 to 2.5% $\Delta v/v$ per 10,000 Mwd/t. This is similar to previous rates. The capsule trains to test unrestrained swelling and fission gas release of mixed carbides started up in the test reactor. The novel, complex instrumented assemblies are measuring fuel temperatures up to 1600°C. The experiments are operating as designed. The second all-mixed carbide subassembly was inserted and started up in EBR-II on schedule. The experiment is operating satisfactorily. The first one, also designed and fabricated by UNC, has attained over 27,000 Mwd/t burnup. Mixed-oxide pellets made from fully enriched ADU source UO_2 and oxalate source PuO_2 were sintered with essentially no hourglassing and diametral variations of less than ±0.0015 in. The plutonium homogeneity was excellent and 100% solid solution was obtained. (J.R.D.)

48577 THEORY OF BUBBLE MIGRATION APPLIED TO IRRADIATED MATERIALS. Oldfield, William; Markworth, Alan J. (Battelle Memorial Inst., Columbus, Ohio). Mater. Sci. Eng., 4: 353-66(Sept. 1969).

Methods of crystal growth are reviewed and applied to the problem of bubbles migrating in solids. The distribution of driving force between the reversible and irreversible processes occurring at the bubble surface is summarized in a coupling equation which illustrates the contributions made by surface curvature, atomic attachment kinetics, impurities contained within the bubble, and vapor diffusion. The shape assumed by a migrating bubble is reviewed, and the special case in which kinetic effects dominate is examined in detail. Lenticular shaped bubbles were found to be a form of cellular growth, resulting from the accumulation of impurities within the bubble. The trails of small bubbles behind such voids revealed the entrainment of impurities as in the grooves of a cellular interface. A procedure is briefly described for evaluating bubble shapes and temperature profiles in the matrix when all features such as capillarity, diffusion and kinetics are considered. (auth)

48578 RADIATION SINTERING. Damask, A. C. (City Univ. of New York, Flushing. Brookhaven National Lab., Upton, N. Y.). Radiat. Eff., 1: 95-100(Apr. 1969).

Observations of sintering of fine particles of diamond, SiO_2, and Al_2O_3 and possibly Al in a neutron radiation field are reported. Possible mechanisms are discussed and it is concluded that the transport of interstitials to the surface is most probably the responsible mechanism. This may occur by diffusion, channeling, or focusing, and it is suggested that measurement of radiation sintering at two temperatures will show if the effect is thermally activated diffusion and that examination of changes in stoichiometry of the sintered interface will show if focusing or channeling dominates as a transport mechanism. Computations are also presented which show that the solar wind on the lunar surface could sinter dust into the observed clumps in a reasonable length of time. (auth)

48579 X-RAY STUDIES ON PILE-IRRADIATED CALCITE. Luthra, J. M. (Bhabha Atomic Research Centre, Bombay). Indian J. Pure Appl. Phys., 7: 444-5(June 1969).

The experimentally observed broadening of x-ray-diffraction profiles of pile-irradiated calcite was resolved into (i) effects due to particle size and (ii) distortion of lattice. By using Warren and Averbach's method, it is shown that broadening is due to strain in the lattice as well as due to small particle size (370 Å). (auth)

48580 VITROCERAMIC NUCLEAR FUEL. Lungu, Sterian (Institutul de Fizica Atomica, Bucharest). Stud. Cercet. Fiz., 21: 389-27(1969). (In Rumanian).

The use, fabrication, structure, and properties of vitroceramic nuclear fuel are discussed. Phase diagrams for the SiO_2-UO_2, SiO_2-ThO_2, and $SiO_2-ThO_2-UO_2$ systems and a statistical thermodynamics model for the interpretation of the immiscibility in the melts of these systems are given. Irradiation damage in vitroceramic nuclear fuel at low and high burn-up and the contribution of the SiO_2 phase are described. The diffusion of fission gases of Xe or Kr in SiO_2-UO_2 fuel is discussed. (G.M.C.)

Plastics and Other Materials

Refer also to abstracts 47467 and 48448.

48581 (DP-1209) IODINE AND NOBLE GAS RETENTION STUDIES. Progress Report, October 1966-December 1968. Milham, Robert C.; Jones, Larry R. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). Aug. 1969. Contract AT(07-2)-1. 22p. Dep. CFSTI.

The removal of iodine from activated carbon by flowing air was measured to evaluate various carbons and to evaluate the effects of variables, such as service, temperature, partial regeneration, iodine loading, and face velocity on iodine desorption. The effect of gamma radiation on the adsorption of iodine and methyl iodide on activated carbon exposed to flowing mixtures of steam and air was measured. Test conditions simulated a postulated loss-of-coolant accident where adsorption of radioiodine on carbon beds in the confinement system would produce an intense gamma field. (auth)

48582 (GA-8305) PROPOSED STUDY ON PROPERTIES OF CONCRETE FOR PRESTRESSED CONCRETE REACTOR VESSEL USAGE. Final Report. Ople, F. S.; White, R. N.; Franklin, R. N. (Gulf General Atomic, Inc., San Diego, Calif.). Apr. 30, 1968. Contract W-7405-eng-26; Subcontract 2827. 199p. Dep. CFSTI.

For Union Carbide Corp., Oak Ridge, Tenn. Nuclear Div.

A comprehensive program to study the behavior of concrete subjected to general stress states and elevated temperatures is proposed. Tests will be conducted on a single concrete mix, but selected tests will be carried out on mix components, and on mixes with other aggregates. Experiments on the influences of stress, temperature, concrete maturity at time of loading, and the duration of loading on the creep of PCRV concrete will be made. Creep of concrete subjected to multiaxial stresses will be explored in detail, with particular emphasis on using the creep and Poisson's ratio functions from uniaxial tests for predicting multiaxial creep. Short-term, room-temperature loading tests on the primary mix are proposed to establish complete stress-strain relationships for multiaxial stress states, as well as a general failure criterion for the concrete. Moisture distribution and its effects on concrete properties, basic thermal properties, and concrete properties under very high temperatures will be investigated. Structural tests will be made in two phases. Specimen configurations and loading techniques are discussed. The schedule and cost are outlined. (J.C.W.)

48583 (ORO-638) AN INVESTIGATION OF CERTAIN PHYSICAL AND MECHANICAL PROPERTIES OF WOOD-PLASTIC COMBINATIONS. Ellwood, Eric; Gilmore, Robert (North Carolina State Univ., Raleigh); Merrill, James A.; Poole, W. Kenneth (Research Triangle Inst., Durham, N. C.). May 1969. Contract AT(40-1)-2513. 159p. (RTI-2513-T-13). Dep. CFSTI.

Four species of wood (red oak, loblolly pine, yellow poplar, white pine) impregnated with four monomers [methyl methacrylate (100%); methyl methacrylate (88%) and phosgard (12%); styrene (60%) and acrylonitrile (40%); ethyl acrylate (80%) and acrylonitrile (20%)] to loadings from 0 to 100% were irradiated with gamma rays from a cobalt-60 source to affect polymerization. The physical and mechanical properties of the wood-polymer combinations were studied. A statistical analysis of the results established trends of the modification of mechanical properties as a function of loading. The greatest improvement in properties of wood polymer as compared to untreated wood was achieved for the following: side hardness (up to 11-fold increase), abrasion resistance (up to 7-fold increase), and compression perpendicular to grain (up to 6-fold increase). The most interesting results were the high antiswell efficiencies of the wood-styrene and acrylonitrile combinations. The efficiencies were up to 60 to 70%; 100% would indicate no swelling of the wood polymer. (auth)

48584 SURFACE MATERIALS USED IN THE FACILITIES FOR NUCLEAR POWER AND RADIOISOTOPES. γ RADIATION EFFECTS ON PAINTS. Wadachi, Yoshiki (Japan Atomic Energy Research Inst., Tokai); Yasunaka, Hideo. Radioisotopes (Tokyo), 18: 317-20(Aug. 1969). (In Japanese).

It is desirable that paints used for surface coating to protect facilities for nuclear power and radioisotopes from radioactive contamination have low contaminability, high decontaminability, and radiation resistibility. In order to investigate the influence of γ radiation on paint film appearance and also on the contaminability and decontaminability of the paint, many kinds of paints were exposed to ^{60}Co γ radiations. When the γ-radiation dose was less than 10^7R, JIS product vinyl chloride resin paint, chlorinated rubber paint, and nitrocellulose-acryl resin paint showed low contaminabilities and high decontaminabilities. Two liquid hardening type epoxy resin paints were fairly good with respect to γ-radiation resistibilities. To enable the paint to function as surface materials for radioactive contamination protection, the upper limit of γ-radiation dose was 10^9R. (NSA of Japan)

PHYSICS (GENERAL)

Astrophysics and Cosmology

48585 AMPLIFICATION OF WEAK MAGNETIC FIELDS IN TURBULENT FLOW. Parker, E. N. (Univ. of Chicago). Astrophys. J., 157: 1119-27(Sept. 1969).

The problem of a weak magnetic field carried in a turbulent-velocity field is considered under the circumstance that the velocity field is a prescribed random function of space and time. It is assumed that the time over which the velocity field is correlated with itself is very short. In this approximation the theory of random functions is used to show that the velocity field amplifies the magnetic field at all wave numbers. Thus the calculation establishes that the large-scale components of a magnetic field in a turbulent-velocity field grow without limit as long as the velocity field is maintained. The unlimited amplification is of interest in astrophysical problems. (auth)

48586 INTERNATIONAL CONFERENCE ON LABORATORY ASTROPHYSICS, LUNTEREN, SEPTEMBER 2–7, 1968. A Selection of Papers. Rosenberg, J. (ed.) Physica, 41: 1-223(Feb. 21, 1969). (In English and French). (CONF-680965).

Topics covered include questions of molecular spectroscopy, physical properties of interstellar matter, and recent developments in astronomical spectroscopic instrumentation. Separate abstracts were prepared for 23 of the 25 papers presented. (W.D.M.)

For abstracts of individual papers see: 48609–48613, 48651–48657, 48666, 48667, and 48677–48685.

Stars

Refer also to abstract 49177.

48587 SPECTRUM OF THE TWO-PHOTON EMISSION FROM THE METASTABLE STATE OF SINGLY IONIZED HELIUM. Artura, C. J.; Tolk, N.; Novick, R. (Columbia Univ., New York). Astrophys. J., 157: L181-6(Sept. 1969).

Verification was made of the theoretically predicted spectral distribution of the two-photon emission from the metastable $2^2S_{\frac{1}{2}}$ state of singly ionized helium by means of a broad-band spectroscopic coincidence counting technique. (auth)

48588 INFRARED EXCESS OF RY SGR. Lee, T. A. (Goddard Inst. for Space Studies, New York); Feast, M. W. Astrophys. J., 157: L173-6(Sept. 1969).

A large infrared excess was found for RY Sgr, an R CrB-type variable star. During a recent 8-month interval the visual brightness increased, while the radiation in the infrared, in the 2- to 3.4-μ region decreased. These observations support the general model for R CrB proposed by Stein et al., in which the infrared flux is ascribed to blackbody radiation from a circumstellar cloud of particles ejected at the time of deep minimum. (auth)

48589 ABUNDANCES IN A HALO PLANETARY NEBULA. Miller, Joseph S. (Univ. of California, Santa Cruz). Astrophys. J., 157: 1215-23(Sept. 1969).

Photoelectric measurements of emission-line intensities were obtained for a planetary nebula of relatively low density and moderate excitation located near the north galactic pole. Considerations of the Hβ flux, apparent diameter, and electron density suggest a distance of approximately 20 kpc. The value N(He)/N(H) = 0.13 for this object is similar to that found in the planetary in M15 and disk planetaries in general. Its oxygen-to-hydrogen ratio is near the lower limit found for disk planetaries. The neon abundance is low in comparison with that found in typical planetaries, though it is similar to that measured for the one in M15. It is suggested that this object is a halo planetary nebula with oxygen and neon abundances intermediate between those of the planetary in M15 and disk planetaries in general. (auth)

48590 SPECTROPHOTOMETRIC STUDIES OF GASEOUS NEBULAE. XIV. THE BRIGHT MODERATE-EXCITATION PLANETARY IC 5217. Czyzak, S. J. (Ohio State Univ., Columbus. Aerospace Research Labs., Wright-Patterson AFB, Ohio); Aller, L. H.; Leckrone, David. Astrophys. J., 157: 1225-9 (Sept. 1969).

Relative spectral-line intensities obtained by photographic and photoelectric spectrophotometry are given for the bright northern planetary IC 5217. The Balmer decrement suggests that the interstellar absorption must be small. Furthermore, the nebula must be relatively homogeneous. (auth)

48591 THE INSTABILITY OF THE CONGRUENT DARWIN ELLIPSOIDS. Chandrasekhar, S. (Univ. of Chicago). Astrophys. J., 157: 1419-34(Sept. 1969).

A class of synchronous coupled oscillations of the congruent Darwin ellipsoids is considered; and it is shown that two of the five modes of oscillation belonging to this class excite instabilities along the entire Darwin sequence. (auth)

48592 FAINT EMISSION LINES OF GASEOUS NEBULAE. Kaler, J. B. (Univ. of Illinois Observatory, Urbana); Aller, L. H. Astrophys. J., 157: 1231-44(Sept. 1969).

Tracings of the long-exposure plates used in the studies of NGC 7009, NGC 6572, and IC 4997 were reexamined, and the intensities of many faint spectrum lines that lie just above the plate-noise limit were identified and measured. The intensities of a number of lines which were previously identified visually but for which no intensity measurements were originally made were also measured, and some errors in the earlier work are corrected. (auth)

48593 CLASSIFICATION OF EMISSION-LINE SPECTRA OF PLANETARY NUCLEI. Smith, Lindsey F. (Univ. of Colorado, Boulder); Aller, Lawrence H. Astrophys. J., 157: 1245-54(Sept. 1969).

Emission-line spectra of nuclei of planetary nebulae are ordered into five classes according to whether they closely resemble spectra of Population I Of and Wolf–Rayet stars or show marked differences from the latter. Spectra that are closely similar to those of Population I stars are in the minority. One of the classes—which is called the O VI sequence—includes spectra which correspond to extremely high excitation; the nucleus of NGC 5189, which has been tentatively identified as an x-ray source, has a spectrum that falls in this class. (auth)

48594 AN ANALYSIS OF THE PECULIAR A STAR HD 204411. Sargent, W. L. W. (Carnegie Institution of Washington, D. C. California Inst. of Tech., Pasadena); Strom, K. M.; Strom, S. E. Astrophys. J., 157: 1265-78(Sept. 1969).

Well-widened, high-dispersion spectra were used to obtain the identifications and equivalent widths for over 1500 lines between 3700 and 4900 Å for the relatively cool Ap star, HD 204411. A model-atmosphere analysis of these data was performed. The large number of lines used in this study allowed to discuss and rule out any significant departures from LTE in the level populations for the lines, or any large variation of the turbulent-velocity parameter with height. The results suggest a broadening of the Fe peak, an overall enhancement of the Fe peak relative to H, and a decrease in the ratio of light-element abundances to iron. The evidence also indicates that the s-process elements Sr and Zr have normal abundances relative to Fe. (auth)

48595 SCANNER ABUNDANCE STUDIES. I. AN INVESTIGATION OF SUPERMETALLICITY IN LATE-TYPE EVOLVED STARS. Spinrad, Hyron; Taylor, Benjamin J. (Univ. of California, Berkeley). Astrophys. J., 157: 1279-1340(Sept. 1969).

A new technique for obtaining differential abundances is described. This technique utilizes the following information: (1) Accurate measures of line and molecular-band strengths, obtained by using a photoelectric spectrum scanner in a manner analogous to that of the Cambridge observers; (2) a self-consistent relative temperature scale based on measures of the star's continuum in the yellow, red, and infrared regions of the spectrum, also obtained with a scanner. With these data, stars may be ordered in terms of their molecular abundances; moreover, quantitative relative abundances may be derived from the measures of atomic-line strengths by using additional information; (3) a simple theoretical treatment for the interpretation of the measured line strengths; (4) at least one comparison star with standard abundances in the temperature range considered. Results obtained to date from an application of this technique to K giants and subgiants are also described. (TSS)

48596 DEPARTURES FROM LTE IN THE HYDROGEN LINES OF LATE B STARS. Peterson, Deane M.; Strom, Stephen E. (Harvard Coll. Observatory, Cambridge, Mass. Smithsonian Astrophysical Observatory, Cambridge, Mass.). Astrophys. J., 157: 1341-61(Sept. 1969).

Departures from LTE for atomic hydrogen were computed under the assumption of detailed balance in the hydrogen lines for a number of models of B star atmospheres. This assumption was found to be valid not only for the physical conditions encountered in B stars of all luminosities but also for a much wider range of temperatures and luminosities. The model atmospheres were com-

pared with previous non-LTE calculations; the differences between the results can be attributed in large measure to the differences in the assumed values of rates of bound–bound and bound–free collisions. The departure coefficients b_n, computed from the models were used to predict the behavior of the wings of Hα, Hβ, Hγ, and Hδ; detailed balance for the line transitions was assumed in computing the b_n. For stars of luminosity lower than that attributed to class III, the departures had virtually no measurable effect. For stars of higher luminosity, a comparison of the wings of Hα and Hγ was found to provide a sensitive test of departures from LTE in the atmosphere. Photoelectric and photographic observations of these Balmer lines were obtained for a number of B stars. The observations suggest that Hα and Hγ are indeed affected by departures from LTE, and that the observed effects are close to those predicted by the models reported. (auth)

48597 EFFECTS OF LINE SHIFTS ON TEMPERATURE DISTRIBUTION IN STELLAR ATMOSPHERES. Mihalas, Dimitri (Univ. of Chicago). Astrophys. J., 157: 1363-7(Sept. 1969).

Simplified models are constructed to estimate the radiative effects upon the temperature structure of a stellar atmosphere due to an abrupt change in the line spectrum at some depth in the atmosphere. The physical motivation is that such changes can occur in the presence of velocity fields or shock fronts in the atmosphere. Significant heating (several hundred to a thousand degrees) occurs, which results in a kind of radiative precursor that appreciably alters the thermodynamic state of the upper atmosphere and hence may influence its response to hydrodynamic phenomena. It may be important to account for these effects in studies of pulsating atmospheres or of mass-loss problems. (auth)

48598 EXPLOSIVE NUCLEOSYNTHESIS IN STARS. Arnett, W. David (Inst. of Theoretical Astronomy, Cambridge, Eng. California Inst. of Tech., Pasadena). Astrophys. J., 157: 1369-80(Sept. 1969).

Conditions for explosive nucleosynthesis in stars are derived for carbon burning and silicon burning. Numerical calculations for explosive carbon burning predict abundances of relevant isotopes which agree remarkably well with those observed in the solar system and in stars. Implications of these results for the theory of the late stages of stellar evolution and for the enrichment of the Galaxy in heavy elements are discussed. (auth)

48599 DIRECT PRODUCTION OF ^{56}Fe IN SILICON QUASI-EQUILIBRIA AND THE PROBLEM OF ^{56}Ni. Clayton, Donald D.; Woosley, Stanford E. (Rice Univ., Houston, Tex.). Astrophys. J., 157: 1381-9(Sept. 1969).

Two questions of importance to the science of nucleosynthesis are considered: (1) Can ^{56}Fe, rather than ^{56}Ni, have been synthesized in its observed ratio to ^{28}Si within a silicon-burning quasi-equilibrium? (2) What accounts for the large abundance of ^{58}Ni? The answer to the first question is in the negative, because a large overabundance of other neutron-rich nuclei, especially ^{54}Fe or ^{52}Cr, appears in the quasi-equilibrium distributions which yield the observed abundance ratio for ^{56}Fe/^{28}Si. The large ^{58}Ni abundance seems to imply one of the following: (1) the iron peak is synthesized in an e-process dominated by ^{56}Ni, in which case the lighter α-particle nuclei are probably synthesized in a cooler mass zone of the same object; (2) the iron peak represents a superposition of at least two considerably different types of equilibrium processes, one accounting for ^{56}Ni and the other accounting for ^{54}Fe and ^{58}Ni; or (3) ^{58}Ni is due to the p-process. Determination of the proper means of production of ^{58}Ni is one of the most important problems associated with nucleosynthesis today. (auth)

48600 ENTROPY OF A RELATIVISTIC ELECTRON GAS. Tooper, Robert F. (California Inst. of Tech., Pasadena). Astrophys. J., 157: 1391-3(Sept. 1969).

An expression for the entropy of a relativistic electron–proton gas is derived, and limiting forms of this expression for the nonrelativistic and extremely relativistic cases are presented. (auth)

48601 ROSSELAND AND PLANCK MEAN ABSORPTION COEFFICIENTS FOR PARTICLES OF ICE, GRAPHITE, AND SILICON DIOXIDE. Keilman, S. A.; Gaustad, J. E. (Univ. of California, Berkeley). Astrophys. J., 157: 1465-7(Sept. 1969).

Rosseland and Planck mean absorption coefficients are computed for ice, graphite, and vitreous SiO_2, over temperature ranges relevant to early phases of star formation. (auth)

48602 NEUTRINO PRODUCTION BY TWO-PHOTON ANNIHILATION. Campbell, J. A. (Univ. of Texas, Austin). Astrophys. J., 157: L177-9(Sept. 1969).

A rate of loss of energy in stellar evolution through two-photon annihilation into neutrino–antineutrino pairs is given. The estimate is valid only if the weak interaction is mediated by an intermediate-vector boson. The effects of various assumptions about the mass of the intermediate-vector boson and about the size of the cutoff for the weak interaction are discussed. (auth)

48603 MASS EXCHANGE IN A MASSIVE CLOSE BINARY SYSTEM. Kippenhahn, R. (Univ., Goettingen, Ger.). Astron. Astrophys., 3: 83-7(Sept. 1969).

A binary system with a primary of 25 $M_\odot$ and a separation of 56 $R_\odot$ is followed through mass exchange after exhaustion of central hydrogen burning. The original primary star ends up as a star of 8.54 $M_\odot$ which almost completely consists of helium. (auth)

48604 QUANTITATIVE ANALYSIS OF THE δ SCUTI-VARIABLE δ DELPHINI. Reimers, D. (Univ., Kiel). Astron. Astrophys., 3: 94-109(Sept. 1969). (In German).

The spectrum of δ Del is analyzed using model atmospheres in nongrey radiative equilibrium. The equivalent widths of about 230 spectral lines are given. By fitting computed continua, colors, hydrogen lines, two hundred spectral lines etc. to the observations an effective temperature $T_e = 7100° \pm 100°$, a surface gravity $\log g = 3.8 \pm 0.2$, and a depth-independent microturbulent velocity $\xi = (7 \pm 0.5)$ km/s are found. It is not possible to attribute different velocity parameters to neutral respectively singly ionized elements. The abundances of the heavy elements up to Fe, with the exception of Mg, are reduced by a factor of 2 relative to the Sun; Mg is underabundant by a factor of 4, Ni is slightly overabundant, and Y and Zr are overabundant by a factor of 2. It is proposed that δ Del is an Ap-type star. The distribution of the elements seems to be similar to that observed in the λ Boo stars. The triplet λ 7771/5 gives an oxygen abundance which is six times larger than the upper limit derived from the permitted lines near λ 6158. This anomaly has been observed already in other A stars. There is evidence of departures from LTE since damping or microturbulent velocity cannot be responsible for this effect. Quantitative computations of the dependence of Strömgren m_1, b–y and c_1 indices on metal abundance and microturbulent velocity have been made by detailed line statistics and model atmospheres. The theoretical results predict correctly the observed metal abundance in δ Del relative to the Hyades. (auth)

48605 MONTE CARLO STUDY OF STARK FIELDS IN DENSE PLASMAS. Gervat, A.; Rossignol-Guzzi, D. (Commissariat a l'Energie Atomique, Limeil, France). Astron. Astrophys., 3: 3-14(Sept. 1969).

Using the Monte-Carlo model of a plasma in thermodynamic equilibrium, proposed by Brush, Sahlin, and Teller, the ionic electric field is studied in order to determine the probability of a given electric field in the plasma. This study may be used in astrophysics to obtain Stark fields influence on opacity. The results obtained are compared with the work of Mayer and Broyles. (auth)

48606 STUDY OF Hα/[NII] RATIO LINES IN THE HELIX NEBULA. Louise, R. (CNRS, Marseille). Astron. Astrophys., 3: 29-30(Sept. 1969). (In French).

Being the largest planetary nebula, "Helix" (NGC 7293) is easily observed with the "Focal Reducer" interferometer. Thus, the radical velocity field has been obtained by Carranza et al. (1967). With the same techniques used by Mein (1968) and Courtes et al. (1969), the Hα/[NII] ratio lines are measured over the Helix Nebula; the electron temperature can be derived from these ratio lines measurements. First results show an increasing Hα/[NII] ratio to the outer parts of the nebula and consequently the electron temperature is decreasing with the distance to the exciting star. (auth)

48607 RADIATIVE TRANSFER IN NOVAE. Babuel-Peyrissac, J. P.; Rouvillois, G. (Commissariat a l'Energie Atomique, Bruyeres-le-Chatel, France). Astron. Astrophys., 3: 31-41 (Sept. 1969). (In French).

Radiative transfer in the interior of two concentric spheres in motion was studied, assuming low density of residual gas. This scheme corresponds to a physical model often used in the study of novae, with an internal star radiating like a black body and an external mantle in rapid expansion. Formulae allow full treatment of the problem on an electronic computer. (auth)

48608 ON THE CALIBRATION OF M_V(K) FOR GIANTS BY MEANS OF TRIGONOMETRIC PARALLAXES. West, R. M. (University Observatory, Copenhagen). Astron. Astrophys., 3: 1-4(Sept. 1969).

A reinvestigation of the problem of calibrating absolute magnitudes derived from H- and K-Line emission reversals for giant stars by means of trigonometric parallaxes was carried out. Systematic errors in the absolute magnitude that arise when stars with small parallaxes are used in the calibration, were computed. Three parameters of the problem, the true spatial

distribution of the observed stars, the mean error of an observed parallax, and the lower limit of the true parallaxes, were varied within reasonable limits. Since the presently available calibration material consists of 33 stars only, the true values of these parameters are only known approximately. It is concluded that the use, in the calibration materials of stars with parallaxes down to 0.030'', may lead to systematic errors in the absolute magnitude equal to or larger than 0.3m. This is in contradiction to the fact that three calibrations by Wilson (1968) based on MK standards, Sun-Hyades, and trigonometric parallaxes agree rather well. (auth)

48609 COHERENT DETECTION SPECTROSCOPY. Van Bueren, H. G. (Observatorium te Utrecht). Physica, 41: 198-208(Feb. 21, 1969).

From International Conference on Laboratory Astrophysics, Lunteren, Netherlands. See CONF-680965.

Various methods of optical spectroscopy are compared, with special emphasis on resolution and acceptance of the systems. It is shown that coherent detection with a laser as a local oscillator has important advantages for specific applications in astronomical spectroscopy and interferometry, especially in the infrared. The merits and disadvantages of coherent detection systems are numerically evaluated, and a recently developed laboratory system is briefly described. Future applications in stellar spectroscopy and interferometry are enumerated. (auth)

48610 SUPERSATURATION OF CARBON VAPOUR IN THE CARBON STARS. II. Kamijo, F. (Tokyo Univ.). Physica, 41: 163-71(Feb. 21, 1969).

From International Conference on Laboratory Astrophysics, Lunteren, Netherlands. See CONF-680965.

The formation of graphite particles in the atmosphere of C-type Mira variables is theoretically investigated using the classical nucleation theory. The result shows that the sublimation takes place fast enough to follow the temperature variation no matter how small the accommodation coefficient may be. The size distribution of the graphite particles is calculated by the nucleation and coagulation theory. (auth)

48611 EVOLUTION OF SILICON CARBIDE PARTICLES IN THE ATMOSPHERES OF CARBON STARS. Friedemann, Chr. (Univ., Jena, Ger.). Physica, 41: 139-43(Feb. 21, 1969).

From International Conference on Laboratory Astrophysics, Lunteren, Netherlands. See CONF-680965.

Assuming isothermic atmospheres for the cool stars the growth and motion of silicon carbide particles were computed for a set of densities in the atmospheres. It is shown that the particles are able to escape in case the surface acceleration is sufficiently low. An estimation of the whole mass of the expelled particles points out that only a small fraction of the interstellar grain dust can be silicon carbide. Nevertheless these particles could be important as condensation nuclei in the interstellar space. (auth)

48612 STUDY OF THE INTENSITY DISTRIBUTION IN THE ABSORPTION SPECTRA OF THE $X^1\Sigma - A^1\Pi$ SYSTEM OF ALUMINUM HYDRIDE. Huron, B. (Observatoire de Paris, Meudon, France). Physica, 41: 58-62(Feb. 21, 1969). (In French).

From International Conference on Laboratory Astrophysics, Lunteren, Netherlands. See CONF-680965.

The relative intensities of the nonpredissociated lines of the $X^1\Sigma - A^1\Pi$ system of AlH and AlD were studied in absorption, and compared to the intensities calculated from the transition probabilities for given temperature and molecular concentration. (auth)

48613 SHOCK TUBE STUDIES ON TWO-PHASE SYSTEMS: OSCILLATOR STRENGTHS OF MOLECULAR BAND SYSTEMS. Hooker, W. J.; Main, R. P. (Heliodyne Corp., Van Nuys, Calif.). Physica, 41: 35-46(Feb. 21, 1969).

From International Conference on Laboratory Astrophysics, Lunteren, Netherlands. See CONF-680965.

The development and testing of a two-phase shock tube utilizing a powder–gas aerosol for the driven fluid is described. The two-phase technique extends the chemical systems that can be studied in a shock tube to include the vaporization products of solid materials. The experimental methods used to measure the uniformity and reproducibility of injected powder distributions are presented. One application of the aerosol-injection shock tubes, a determination of the oscillator strength of the SiO ($A^1\Pi - X^1\Sigma^+$) band system, is described. The value obtained is $f_e = 0.023 \pm 0.013$. (auth)

48614 INFRARED SPECTRUM OF ARCTURUS. Montgomery, Earl F. (Univ. of Texas, Austin); Connes, Pierre; Connes, Janine; Edmonds, Frank N. Jr. Astrophys. J., Suppl. Ser. No. 167, 19: 1-29(Aug. 1969).

Equivalent widths of 1036 stellar lines were measured from high-resolution interferometric spectra of Arcturus covering the spectral range 11,407 to 25,129 Å. Approximately 60% of these lines were identified. (auth)

48615 Ca II K EMISSION IN SOUTHERN LATE-TYPE STARS. Warner, Brian (Univ. of Texas, Austin). Mon. Notic. Roy. Astron. Soc., 144: 333-56(1969).

K-emission widths, intensities, and derived absolute visual magnitudes are given for 200 southern G, K, and M stars, measured on 15 Å mm^{-1} coude spectra obtained at the Radcliffe Observatory. (auth) (UK)

48616 SURFACE BRIGHTNESSES IN THE U, B, V SYSTEM WITH APPLICATIONS ON Mv AND DIMENSIONS OF STARS. Wesselink, A. J. (Yale Univ. Observatory, New Haven). Mon. Notic. Roy. Astron. Soc., 144: 297-311(1969).

The surface brightnesses are expressed in the V system in terms of V_0 and d'' (the angular diameter) with the formula $s_V = V_0 + 5 \log d$. The term s_V is derived for 18 stars from observation and the relation between s_V and $(B-V_B)_0$ is obtained. The central problem is the determination of M_V from R (the linear radius) or vice versa; the formula $M_V - s_V + 5 \log R = +15.15$ is basic for the solution thereof. The use of s_V is compared with a method based on BC and T_e currently employed in the same problem. The two methods are equivalent provided a certain condition is satisfied. Lines of equal radius were drawn in a HR diagram having $(B-V)_0$ and M_V coordinates and the radii of stars along the zero age main sequence are given. The mean absolute magnitude of δ Cephei was derived, in good accord with other modern determinations ($M_V = -3.56$). The absolute magnitudes M_V for the components of some eclipsing variables are derived and a mass–luminosity relation is drawn with small scatter. The dimensions of some supersupergiants belonging to the Magellanic Clouds are calculated; HDE 268757 is one of the largest known stars, with a radius of 10.3 au. A check is made on a published list of BC and T_e, using the present results. (auth) (UK)

48617 YOUNG STELLAR CLUSTERS. Williams, I. P.; Cremin, A. W. (Reading Univ., Eng.). Mon. Notic. Roy. Astron. Soc., 144: 359-73(1969).

Using theoretical evolutionary tracks, masses, and ages of the stars in the young stellar cluster NGC 2264 were determined. This information was used to obtain various cluster properties, such as the age distribution, the mass distribution, and the mass–age correlation. The three clusters NGC 6530, IC 2602, and IC 5146 were also investigated, but in less detail. These produce distribution diagrams similar to NGC 2264. It is concluded that there exists a large age spread in all the clusters and that the rate of formation of stars increases with time. (auth) (UK)

48618 WOLF–RAYET STARS. Proceedings of a Symposium Held at The Joint Institute for Laboratory Astrophysics, University of Colorado, Boulder, Colorado, June 10–14, 1968. Gebbie, Katharine B.; Thomas, Richard N. (eds.). Washington, D. C., National Bureau of Standards, 1968. 286p. GPO $3.00. (NBS-SPEC. PUBL.–307; CONF-680662).

A symposium on Wolf–Rayet stars was held at the Joint Institute for Laboratory Astrophysics on the campus of the University of Colorado, Boulder, June 10 to 14, 1968. The Wolf–Rayet stars represent the most extreme example studied of an interaction between aerodynamic motions and a radiation field to produce a high-temperature, large-scale plasma in a steady but nonequilibrium state. In order to understand them, a knowledge of gases with temperatures between 10^4 and 10^7°K and differential velocities between 0 and 10^3 km/sec is required. In particular, information is needed on radiative and collisional atomic cross sections for a wide range of ions, on collective interactions of ions and photons, on methods of diagnostic spectroscopy, and on velocity fields generated by convective, gravitational, nuclear, radiative, rotational, thermal, and other instabilities. The material of the symposium was divided into four broad topics: the distribution, physical properties, and evolutionary status of Wolf–Rayet stars; the detailed features of their spectra; the interpretations of these features and the models on which they are based; and finally a survey of the material and ideas arising out of the symposium itself. This volume contains the introductory summaries of each of these broad topics, together with an edited version of the discussions which followed. (auth)

48619 EQUATION OF STATE OF NEUTRON GAS AND THE CRITICAL MASS OF NEUTRON STARS. Binder, M.; Pierce, R. H.; Razavy, M. (Univ. of Alberta, Edmonton). Can. J. Phys., 47: 2101-14(Oct. 1, 1969).

The equation of state of the neutron gas is calculated by a variational method, using the Hamada–Johnston potential for the two-nucleon interaction. The energy–density relation determined in this way is valid for low and moderate densities. This result is extrapolated to higher densities and is joined smoothly to the

relativistic energy–density relation for free particles. The critical mass of neutron stars is obtained by integrating the general relativistic equations for hydrostatic equilibrium using the equation of state. The critical mass is found to be less than 0.7 of the mass of the Sun. (auth) (Canada)

48620 VV CEPHEI STARS. Cowley, Anne P. (Univ. of Michigan, Ann Arbor). Publ. Astron. Soc. Pac., 81: 297-331 (Aug. 1969).

This paper summarizes the photometric and spectroscopic investigations of the 13 known VV Cephei-type binaries. The cool primaries are found to be luminous supergiants with irregular or semiregular light variations of less than a magnitude. Descriptions of the spectra of both the hot and cool stars as well as the peculiar emission features are given. Variations in the spectrum are noted and, when possible, their relation to the orbital cycle is discussed. The periods are characteristically long — of the order of a decade or more. Orbital studies indicate that the components have masses in excess of 30 solar masses. The location of these objects in associations or very near the galactic plane implies that they are recently evolved. High dispersion studies of VV Cep itself give evidence for steady mass loss from the primary. The relation of these systems to the much wider pair of stars in α Scorpii is considered. (auth)

48621 ACCURACIES OF RADIAL-VELOCITY MEASUREMENTS. Abt, Helmut A. (Kitt Peak National Observatory, Tucson, Ariz.); Smith, Gregory H. Publ. Astron. Soc. Pac., 81: 332-8(Aug. 1969).

The accuracies of radial velocities measured with current techniques are studied to determine their dependence on dispersion, spectrum width, and line width. It is concluded that (1) illumination or guiding errors still cause a loss of accuracy by a factor of roughly 2; (2) the overall accuracies are much higher than those derived in the past; (3) broadening the spectra above 0.3 to 0.6 mm produces very little improvement for the increased observing time required; (4) increasing the dispersion is generally the best way to increase accuracy; (5) velocity accuracies are almost independent of line width for rotational velocities above about 100 km/sec. (auth)

48622 uvby PHOTOMETRY OF A AND F STARS. Barry, Don C. (Univ. of Arizona, Tucson). Publ. Astron. Soc. Pac., 81: 339-45(Aug. 1969).

uvby photometry for 42 stars transformed to the system of the Strömgren–Perry catalog is presented. The A- and F-type MK standards not contained in the catalog are included. (auth)

48623 STARS WITH MOTIONS OF MORE THAN 100 KM/SEC PERPENDICULAR TO THE GALACTIC PLANE. Eggen, O. J. (Australian National Univ., Canberra). Publ. Astron. Soc. Pac., 81: 346-58(Aug. 1969).

From the space motions of several thousand stars, 40 are found to definitely have velocities perpendicular to the galactic plane greater than 100 km/sec. Most of these stars are of four kinds: CH stars, subdwarfs, short-period cepheids, and horizontal-branch stars. In addition, five giants and subgiants are included. (auth)

48624 ON THE LONG PERIOD OF Nu ERIDANI. Rao, N. Kameswara (Osmania Univ., Hyderabad, India). Publ. Astron. Soc. Pac., 81: 359-64(Aug. 1969).

Observations of ν Eridani on 17 nights spread over a period of 736 days confirm the long period (n_L = 0.0633 cycles/day) of this star. The effect of tidal distortion appears to be present in both the fundamental and the first overtone oscillations. The fact that the two distortions are opposite in phase may be of importance for the theoretical models of pulsating stars. (auth)

48625 OBSERVATIONAL CLUES TO THE EVOLUTION OF M GIANT STARS. Boesgaard, Ann M. (Univ. of Hawaii, Honolulu). Publ. Astron. Soc. Pac., 81: 365-73(Aug. 1969).

High dispersion (4 to 8 Å/mm) spectrograms were used to search for incipient traces of S-star characteristics in a homogeneous sample of M giants. Even at this dispersion there are very few signs that M-star atmospheres are enriched by the elements found in S stars. It is concluded that if M stars evolve into S stars, they do so on a very short time scale. (auth)

48626 UBV OBSERVATIONS OF NOVA VULPECULAE 1968 NO. 1. Fernie, J. D. (Univ. of Toronto). Publ. Astron. Soc. Pac., 81: 374-80(Aug. 1969).

Seventeen UBV observations, including a premaximum observation, obtained between April 16 and December 18, 1968 are presented. The light curves in U and V, but not in B, are found to be almost strictly exponential. (B–V) appears to have been changing steadily from a time before maximum until 110 days after maximum. There are marked differences from the light and color curves of supernovae. It is estimated that the absolute blue magnitude at maximum light was –7.8, that the color excess is 0.6 m, and that the distance of the object is 1.3 kpc. (auth)

48627 UBV OBSERVATIONS OF LONG-PERIOD VARIABLE STARS, VII. Landolt, Arlo U. (Louisiana State Univ., Baton Rouge; Cerro Tololo Inter-American Observatory, La Serena, Chile). Publ. Astron. Soc. Pac., 81: 381-6(Aug. 1969).

Photoelectric observations of 25 long-period variable stars are presented on the UBV photometric system. (auth)

48628 TEMPERATURE DISTRIBUTIONS ON THE SURFACES OF CLOSE BINARY STARS. Chen, Kwan-yu (Univ. of Florida, Gainesville); Rhein, Walter J. Publ. Astron. Soc. Pac., 81: 387-98(Aug. 1969).

Close binary stars are assumed to be opaque blackbodies with limb darkening. The increase of temperature due to radiative transfer between the components is calculated employing realistic geometry of spheres. The method is valid both for the regions of full illumination and for the penumbras. The computations employ iterative techniques and allow for variations of six parameters, two each of radius, temperature, and limb darkening. Some of the results are compared with those of previous models and calculations. These temperatures will be useful to predict the variation of the monochromatic reflection effect with phase and with the above-mentioned parameters. (auth)

48629 NARROW-BAND AND INTERMEDIATE-BAND PHOTOMETRY OF GLOBULAR STAR CLUSTERS. Johnson, S. L.; McNamara, D. H. (Brigham Young Univ., Provo, Utah). Publ. Astron. Soc. Pac., 81: 415-25(Aug. 1969).

Narrow-band and intermediate-band photometry of the integrated light of globular star clusters in the uvby and β photometric systems are described. The observational results are used to derive the reddening of the clusters. Reddened-free indices are calculated and are shown to be related to the metal abundances of the member stars of the clusters. (auth)

48630 POLARIMETRIC OBSERVATIONS OF LATE-TYPE DWARFS. Zappala, R. R. (Univ. of California, Santa Cruz). Publ. Astron. Soc. Pac., 81: 433-7(Aug. 1969).

Ten dM and dMe stars were observed polarimetrically. None of the stars, including the UV Ceti variable AD Leo, appeared to have intrinsic plane polarization during the period of observation. The mean observed polarization was 0.11%. For unpolarized stars the observational error involved would have produced an apparent mean polarization of 0.09%. (auth)

48631 IDENTIFICATION OF G- AND K-TYPE GIANT STARS AT LOW DISPERSION. Upgren, A. R. (Wesleyan Univ., Middletown, Conn.). Publ. Astron. Soc. Pac., 81: 438-40(Aug. 1969).

It is shown that G and K stars, even those at large distances from the galactic plane, can be reliably classified for luminosity at low dispersion. The classification is based mainly on the two CN bands (at 3820–3880 and 4130–4215) even though they are known to reflect variations in stellar population. (W.D.M.)

48632 NEW COMPOSITE SPECTRUM OF THE VV CEPHEI TYPE. Humphreys, Roberta M. (Univ. of Michigan, Ann Arbor, Kitt Peak National Observatory, Tucson, Ariz.). Publ. Astron. Soc. Pac., 81: 440-3(Aug. 1969).

The late-type supergiant, HD 237006, was recently found to have a composite spectrum. The first plate of HD 237006 taken in Nov. 1967 shows a spectrum similar to those of stars of the VV Cephei type. The spectrum and radial velocity are given for HD 237006. (W.D.M.)

48633 UBV OBSERVATIONS OF SELECTED DOUBLE SYSTEMS. II. Landolt, Arlo U. (Louisiana State Univ., Baton Rouge; Cerro Tololo Inter-American Observatory, La Serena, Chile). Publ. Astron. Soc. Pac., 81: 443-6(Aug. 1969).

UBV magnitudes and color indices were obtained for 22 double systems listed in the Bright Star Catalogue for which these data have been lacking. (auth)

48634 SUBLUMINOUS STARS. IV. RED SUBLUMINOUS STARS AND STARS WITH A HIGH ULTRAVIOLET EXCESS. Eggen, O. J. (Australian National Univ., Canberra). Astrophys. J., Suppl. Ser. No. 168, 19: 31-78(Sept. 1969).

A sample of 1000 southern, late-type proper-motion stars yields 419 objects with B–V between +0.35 and +1.1 mag. These 419 stars contain (a) 300 stars which from the colors alone could be subdwarfs, but the tangential velocity for 10% of which would be in excess of the total space motion observed in known subdwarfs, (b) 48 stars with ultraviolet excesses up to 0.1 mag larger than expected from the abundance effect, of which 30%, if subdwarfs, have excessive tangential velocity, and (c) 71 stars with still larger ultraviolet excesses that may all be subluminous objects.

From the transverse velocity alone some 15% of the 419 stars are probably subluminous. Trigonometric, cluster, and photometric parallaxes for wide binary systems all indicate the presence of subluminous stars populating the supposedly empty region of the H–R diagram between the main-sequence G- and K-type stars and the classical white dwarfs. These stars may be spectroscopically indistinguishable from subdwarfs. Identification charts are reproduced for some stars discussed here and not already identified elsewhere. (auth)

Quasi-Stellar, Radio, and X-Ray Sources

48635 (N–69–31004) A BALLOON BORNE X-RAY SURVEY OF THE CYGNUS REGION. Reinert, Charles Peter (Minnesota Univ., Minneapolis. Cosmic Ray Group). June 1969. 100p. (NASA-CR–103221; CR–132). CFSTI.

Thesis.

Localized celestial sources of x rays were surveyed in the Cygnus constellation by means of balloon-borne detectors. The design of the x-ray detector is described, with consideration given to the background radiation problems. Data from an actual flight are analyzed, and results are discussed. One of the results is an indication of a steepening of the energy spectrum in the vicinity of 100 keV. Tables and charts summarizing the experiment are included. (STAR)

48636 (UCRL-Trans–10369) OBSERVED X-RAY EMISSION FROM THE CRAB NEBULA AND SKY BACKGROUND. Ducros, G.; Ducros, R.; Rocchia, R.; Tarrius, A. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Translated by W. Robinson for Univ. of California, Lawrence Radiation Lab., Livermore, from a Preprint. 22p. Dep. CFSTI.

Results are presented of an astronomical experiment in the 2.5 to 30 keV x-ray energy range carried out in December 1968 aboard a rocket with an attitude-control system. The detectors were two proportional counters whose axes were aimed at the Crab Nebula and a point in the sky not in the galactic plane (RA 2 hr 24 min 30 sec, $\delta = -40°$). Experimental findings are given. (TSS) (auth)

48637 PRECISION MEASUREMENT OF THE FREQUENCY DECAY OF THE CRAB NEBULA PULSAR, NP 0532. Boynton, P. E.; Groth III, E. J.; Partridge, R. B.; Wilkinson, David T. (Princeton Univ., N. J.). Astrophys. J., 157: L197-201(Sept. 1969).

The phase of optical pulses from NP 0532 was measured against an atomic time standard. The first 6 weeks of observation gave the pulsar frequency ν and its time derivatives ν_t (= $d\nu/dt$), and ν_{tt} in agreement with earlier measurements, but with improved accuracy. It was found that $(\nu_{tt}\nu/\nu_t^2) = 4.76 \pm 0.65$. This preliminary result is consistent with angular-momentum loss by gravitational radiation. (auth)

48638 A GENERAL DISCUSSION OF THE DISTRIBUTION OF BRIGHTNESS OF EXTRAGALACTIC RADIO SOURCES. Fomalont, E. B. (California Inst. of Tech., Pasadena). Astrophys. J., 157: 1027-45(Sept. 1969).

The brightness distribution of extragalactic radio sources, based mainly on recent observations at the California Institute of Technology, is described and discussed. The paper concentrates on displaying general properties of radio sources rather than a discussion of individual sources. The angular scale and the morphological types of radio structures are discussed. Approximately one-third of the sources are true doubles composed of two similar components. Other common structure types are complex sources, core-halo sources, and double sources whose components have unequal diameters. However, many of these sources still show a double-type symmetry. Sources with simple structures are rare. A method is outlined for analyzing the structure of a large sample of sources by using the visibility function. The section gives the distributions of angular size, percentage, and size of fine structure, "symmetry," and "compactness" of radio sources determined by use of this method. A comparison of the radio structure with optical structure, radio luminosity, and radio diameter suggests that the gross radio structure depends only on the radio luminosity. Furthermore, as a component recedes from a galaxy, its diameter expands at a velocity proportional to the recessional velocity. This type of component evolution defines a "cone of ejection" from the galaxy with an opening of ~25° for the more luminous sources and ~50° for the weaker sources. The spatial properties of the radio structure and the galaxy are discussed. For double sources the galaxy lies close to the midpoint of the two components, perhaps a bit closer to the stronger component. For the doubles with unequal diameters, the galaxy is definitely situated closer to, sometimes coincident with, the smaller-diameter component. It is suggested that some of these sources are similar to 3C 83.1 (NGC 1265). The galaxy is coincident with the core component of core-halo sources. Variable radio galaxies tend to have a core-halo structure, and it is suggested that the halo and the core are the same age since halo-type components are not observed alone. Most complex sources are probably genetically related to the simpler sources. (auth)

48639 OBSERVATION OF HARD RADIATION FROM THE REGION OF THE GALACTIC CENTER. Haymes, R. C.; Ellis, D. V.; Fishman, G. J.; Glenn, S. W.; Kurfess, J. D. (Rice Univ., Houston, Tex.). Astrophys. J., 157: 1455-9(Sept. 1969).

A balloon-altitude observation of Sagittarius was conducted on April 23, 1968, at photon energies between 31 and 544 keV. A power-law spectrum of the form $2.8\ E^{-2.20\pm0.35}$ photons cm^{-2} sec^{-1} keV^{-1} was detected, corrected to the top of the Earth's atmosphere. If the entire flux is assumed to be from the source known as GX 3 + 1, the corresponding number spectrum becomes $4.4\ E^{-2.23\pm0.35}$ photons cm^{-2} sec^{-1} keV^{-1}; a power law similar in shape to that of the Crab Nebula appears to provide a better fit than an exponential to the spectrum over a broad energy range. (auth)

48640 ELECTRON TEMPERATURES OF H II REGIONS. Rubin, Robert H. (National Radio Astronomy Observations, Green Bank, W. Va.). Astrophys. J., 157: 1461-3(Sept. 1969).

The very low electron temperatures found for H II regions from the best isothermal fit of the radio-flux-density spectrum are shown to be lower limits. In view of this, the temperature structure of the Orion Nebula is reexamined. (auth)

48641 ACCELERATION OF ULTRARELATIVISTIC ELECTRONS AND NUCLEI IN NONTHERMAL RADIO SOURCES. Burke, John R.; Layzer, David (Harvard Coll. Observatory, Cambridge, Mass.). Astrophys. J., 157: 1169-81(Sept. 1969).

Previous papers outlined a theory for the genesis of ordered magnetic fields and the acceleration of charged particles in nonthermal radio sources. The present paper gives a detailed analytic and numerical discussion of the acceleration process, which verifies the principal assumption underlying the previously given derivation of a differential energy spectrum of the form $N(E) \propto E^{-\gamma}$ with $\gamma > 2$. (auth)

48642 ACCELERATION OF RELATIVISTIC PARTICLES IN THE CRAB NEBULA. Michel, F. Curtis (Rice Univ., Houston, Tex.). Astrophys. J., 157: 1183-99(Sept. 1969).

On the basis of an acceleration mechanism proposed earlier, a model is developed to describe the synchrotron emission expected from objects such as the Crab Nebula. It is proposed to transfer energy from magnetic fields into relativistic particles with essentially 100% efficiency, the electron energy being converted into synchrotron radiation also with 100% efficiency. This acceleration is shown to take place at neutral sheets within the magnetic field. On the basis of the acceleration mechanism and the observed properties of the Crab Nebula (luminosity and spectral shape) one can express the bulk parameters (magnetic-field strength, individual and total electron energy, and background plasma concentration) in terms of the total area of the surfaces of the neutral sheets separating magnetic-field discontinuities. Observation of the wisps first reported by Baade indicates that the area of such neutral sheets is $\sim 10^2$ the projected nebular area, suggesting that ambient plasma at a concentration of 2×10^{-4} cm^{-3} is accelerated in magnetic fields of 10^3 γ to energies of 10^{10} eV. The rms field within the nebula is expected to be more like 10^2 γ. This plasma density is consistent with that deduced by Scargle on the basis of the wisp motions. (auth)

48643 ON THE NATURE OF PULSARS. I. THEORY. Ostriker, J. P.; Gunn, J. E. (Princeton Univ. Observatory, N. J.). Astrophys. J., 157: 1395-1417(Sept. 1969).

The initial installment of a quantitative exploration of one particular pulsar model is presented. It is assumed that the seat of the pulsar phenomenon is a rotating neutron star having a dipolar magnetic field which is not parallel to the rotation axis. It is shown that such stars may be expected to emit large amounts (10^{50} to 10^{52} ergs) of magnetic-dipole and gravitational–quadrupole radiation, that these energy losses are inevitably associated with losses of angular momentum and increases in the rotation periods, and that the emitted low-frequency magnetic-dipole radiation is extremely efficient at accelerating charged particles to relativistic energies. An explicit expression for the period as a function of time allows to calculate the age of the Crab Nebula (with ≈20% accuracy) and to predict the so far unobserved second derivative of the period (d^2P/dt^2). The luminosity of the nebula and the highest-energy electrons presently being injected into it are determined, both numbers found to be in good agreement with independent observations. In extreme cases the acceleration mechanism can produce protons with energies up to $m_p c^2 (e^2/Gm_p^2)^{1/4}$

or 10^{21} eV, which is somewhat in excess of the most energetic cosmic rays yet observed. The theory predicts a relation between period, P, and rate of change of period, $dP/dt \approx 3 \times 10^{-15}/P(\text{sec})$, which is well observed, in the mean, for pulsars. Finally, after determining the magnetic decay time to be about 4 million years, it is predicted that few pulsars should be found with periods in excess of 1.5 seconds, also in good accord with observations. The origin of the pulses is not discussed. (auth)

48644 ARECIBO OCCULTATION STUDIES: LIST 3. Gulkis, S.; Sutton, J.; Hazard, C. (Cornell–Sydney Univ. Astronomy Center, Ithaca, N. Y.). Astrophys. J., 157: 1047-53(Sept. 1969).

The positions and structures of ten radio sources are derived from occultation observations. Optical identifications are suggested for six of the sources. (auth)

48645 ON THE POSSIBILITY OF DETECTING REDSHIFTED 21-CM ABSORPTION LINES IN THE SPECTRA OF QUASI-STELLAR SOURCES. Bahcall, John N. (California Inst. of Tech., Pasadena); Ekers, Ronald D. Astrophys. J., 157: 1055-64(Sept. 1969).

The expected strengths of redshifted 21-cm absorption lines are estimated by using the properties of the observed optical absorption lines in quasi-stellar sources. It is shown that the absence of O I and N I absorption lines in the observed optical absorption spectra of quasi-stellar radio sources indicates that 21-cm absorption lines wider than 100 kHz are likely to be weak unless the heavy-element abundance in the absorbing material is low. Lines narrower than 100 kHz may be strong; their optical counterparts would have escaped detection. A general expression is given for the spin temperature of neutral hydrogen when (following Field) Ly α excitation and de-excitation, 21-cm absorption and emission, and particle collisions are all included. The results are expressed simply in terms of the strength and distance of the radio source and the separation between absorber and emitter. It is shown that the spin temperature of neutral hydrogen is large near a quasi-stellar radio source and is determined either by the ambient 21-cm flux or the ambient Ly α flux for separations between absorber and emitter of less than about 10^5 lt-yr. The expected absorption (and emission) strengths of redshifted 21-cm lines are compared with observational capabilities at radio observatories. Some interesting candidates for study are listed. (auth)

48646 QUASI-STELLAR OBJECTS IN THE DIRECTION OF CLUSTERS OF GALAXIES. Bahcall, John N. (California Inst. of Tech., Pasadena). Astrophys. J., 157: L151-2(Sept. 1969).

Twenty-one quasi-stellar objects are listed that are in the direction of clusters of galaxies. These objects are interesting candidates for absorption experiments. (auth)

48647 ON THE PRODUCTION OF QSO ABSORPTION SPECTRA IN FRIEDMANN UNIVERSES. Roeder, R. C. (Univ. of Toronto). Astrophys. J., 157: L153-4(Sept. 1969).

It is shown that the hypothesis of Bahcall and Spitzer concerning the origin of absorption lines in QSOs is apparently inconsistent with present observations. (auth)

48648 RECENT APPEARANCE OF A NEW X-RAY SOURCE IN THE SOUTHERN SKY. Conner, J. P.; Evans, W. D.; Belian, R. D. (Los Alamos Scientific Lab., N. Mex.). Astrophys. J., 157: L157-9(Sept. 1969).

The recent appearance of a strong x-ray source in the southern sky was observed with detectors aboard two Vela 5 satellites. The satellite data indicate that the source appeared between 2330 U.T. July 6 and 0430 U.T. July 9, 1969, and is located at approximately R.A. 14^h56^m, decl. $-32°15'$. During the first few days this source increased in strength and then began to decline. At its peak it was more than twice as strong as Sco XR-1 in the energy range 3 to 12 keV. The spectrum of this source has grown softer continuously since its appearance. (auth)

48649 SEARCH FOR STRONG RADIO SPECTRAL LINES IN THE RANGE 20 TO 25 GHz. Howard III, William E.; Hvatum, Hein (National Radio Astronomy Observatory, Green Bank, W. Va.). Astrophys. J., 157: L161-2(Sept. 1969).

The radio sources W3A, VY Canis Majoris, and W49 were searched for strong radio spectral lines in the frequency range 20 to 25 GHz on April 27–29, 1969, with the NRAO 140-foot radio telescope. No lines stronger than 3000 flux units were present in the three sources at the time of observation. (auth)

48650 SPECTRUM OF THE COSMIC RADIO BACKGROUND BETWEEN 0.4 AND 6.5 MHz. Alexander, J. K.; Brown, L. W.; Clark, T. A.; Stone, R. G.; Weber, R. R. (Goddard Space Flight Center, Greenbelt, Md.). Astrophys. J., 157: L163-5(Sept. 1969).

Measurements of the average spectrum of the radio background for a broad region near the north galactic pole were obtained over the range 0.4 to 6.5 MHz on the basis of experiments on the Radio Astronomy Explorer satellite. The spectrum turns over below 4 MHz in a manner that supports the concept of a uniform admixture of galactic emission regions having a spectral index of 0.43 ± 0.05 and absorbing ionized-hydrogen regions having a mean electron density of about 0.03 cm^{-3} in the galactic disk. (auth)

48651 FRONTS OF H II REGIONS. Ahlborn, B. (Univ. of British Columbia, Vancouver). Physica, 41: 190-2(Feb. 21, 1969).

From International Conference on Laboratory Astrophysics, Lunteren, Netherlands. See CONF-680965.

The densities of some H I clouds near the fronts of H II regions are calculated with gasdynamical methods using observational data from the literature for electron density, temperature, and particle velocity inside the H II region. (auth)

48652 EXPERIMENTAL INVESTIGATION OF RADIATION FRONTS. Zuzak, W. W.; Ahlborn, B. (Univ. of British Columbia, Vancouver). Physica, 41: 193-7(Feb. 21, 1969).

From International Conference on Laboratory Astrophysics, Lunteren, Netherlands. See CONF-680965.

The dynamical properties of plane radiation fronts were investigated. Five types of steady radiation fronts are possible, depending on the ratio of photon flux to absorber density. In an associated experiment unsteady dissociation fronts are produced. The measurements are compared with calculations based on a modified method of characteristics. (auth)

48653 RELAXATION PHENOMENA IN AN IONIZED SHOCK FRONT. Nakai, S.; Kasuya, K.; Yamanaka, C. (Osaka Univ.). Physica, 41: 213-17(Feb. 21, 1969).

From International Conference on Laboratory Astrophysics, Lunteren, Netherlands. See CONF-680965.

The ionization process in the shock-front structure in argon using various experimental techniques was investigated: 10-GHz microwave reflection method, 70-GHz mm-wave interferometer, laser light scattering, spectroscopy, and electric probes. To drive high-speed shock waves, the electromagnetically driven (EM) shock tube and pressure-driven shock tube with two diaphragms were used. (auth)

48654 ANALYSIS OF TWO BAND SYSTEMS OF CH^+: $^1\Delta \rightarrow {}^1\Pi$ AND $^3\Sigma \rightarrow {}^3\Pi$. Carre, M. (Faculte des Sciences, Lyon). Physica, 41: 63-6(Feb. 21, 1969).

From International Conference on Laboratory Astrophysics, Lunteren, Netherlands. See CONF-680965.

Emission spectra of CH_4 and C_2H_2 excited by proton impact were studied. In addition to the well-known band systems of CH and CH^+ two new systems ascribed to $^1\Delta \rightarrow {}^1\Pi$ and $^3\Sigma \rightarrow {}^3\Pi$ of CH^+ appear and and they were analyzed. (auth)

48655 SOME RECENT RESULTS CONCERNING THE FINE STRUCTURE IN THE SPECTRUM OF THE OH^+ MOLECULE. Rakotoarijimy, D. (Observatoire de Paris, Meudon, France). Physica, 41: 29-34(Feb. 21, 1969). (In French).

From International Conference on Laboratory Astrophysics, Lunteren, Netherlands. See CONF-680965.

The electronic system $^3H_1 - {}^3\Sigma^-$ of OH^+ was photographed during emission in a discharge analogous to that of Wood. The analysis of the (0,0), (0,1), (1,0), (1,1), and (2,2) band structure observed in the high-resolution spectra furnished new values of molecular constants more coherent than those noted previously. Values for constants of vibration, rotation, those for the splitting (Λ) of the excited level $^3\Pi_1$, fine-structure constants λ and γ, and for the coupling constant A, are given. The frequencies of numerous rotation lines are compared with those measured in the spectrum of comet tails by Hunnaets and Swings. (tr-auth)

48656 ON THE PHOTODISSOCIATION OF INTERSTELLAR H_2 AND CH MOLECULES. Dressler, K. (Princeton Univ. Observatory, N. J.). Physica, 41: 27-8(Feb. 21, 1969).

From International Conference on Laboratory Astrophysics, Lunteren, Netherlands. See CONF-680965.

The photodissociation of molecular hydrogen in H I regions by the mechanism discussed by Stecher and Williams has been examined quantitatively in more detail by Liszt. Numerical results are presented and discussed in connection with the observations of CH and other interstellar molecules. (auth)

48657 HYDROXYL MOLECULE IN INTERSTELLAR SPACE. Cook, A. H. (National Physical Lab., Teddington, Eng.). Physica, 41: 1-23(Feb. 21, 1969).

From International Conference on Laboratory Astrophysics, Lunteren, Netherlands. See CONF-680965.

A historical introduction and an outline of the radio-frequency spectroscopy of the OH molecule is followed by a description of radio-frequency absorption by galactic OH and of radio emission

from OH in dust clouds. The outstanding features of anomalous radio emission from sources associated with H II regions are described and an account of the interpretation in terms of stimulated emission is given, emphasis being laid on a phenomenological description of the observations. Finally, the implications of the observations for the dynamics and contents of interstellar gas, and for the processes going on within it, are considered and the extent of the ignorance of the properties of the OH molecule and the further need for laboratory investigation are indicated. (auth)

48658 SEARCH FOR REDSHIFTED NEUTRAL HYDROGEN ABSORPTION IN 3C 191. Skuter, W. L. H.; Gower, J. F. R. (Univ. of British Columbia, Vancouver). Nature (London), 223: 1046(Sept. 6, 1969).

It has been suggested by Burbidge that the red shift $Z = 1.95$ observed in quasars may have special significance. The present authors attempted to detect absorption in the ground-state hyperfine transition of neutral H atoms, occurring normally at 21 cm, and redshifted to 62 cm in the continuum flux of 3C 191. This object shows optical absorption lines at $Z = 1.9458 \pm 0.001$, and the corresponding neutral hydrogen absorption would be expected at 482.180 ± 0.160 MHz. The continuum flux is $S_{482} = 5$ flux units. Observations were made on Feb. 7, 1969 using the 25.6-m antenna at the Dominion Radio Astrophysical Observatory over the frequency range 482.180 ± 0.500 MHz. The resulting spectrum indicated that the absorption did not exceed 6% of the continuum flux. The results are considered to constitute evidence against the hypothesis that quasar absorption lines are produced by normal galaxies in the intervening path, since the disk of a spiral galaxy between us and a quasar would be expected to be about ~25% of the continuum flux of the quasar. (UK)

48659 OPTICAL VARIATIONS IN QUASARS. Hunter, J. H.; Lii, P. K. (Yale Univ., New Haven). Nature (London), 223: 1045-6(Sept. 6, 1969).

Results are summarized of a photographic survey of selected quasars conducted over 2½ years with the Yale 40-inch telescope. Approximate photographic magnitudes are given, together with approximate maximum amplitudes of the optical variations in magnitudes. Light curves for quasars showing variations ≈0.5 m, and for 3C 181, are also shown. Evidence was found for "outbursts" with amplitudes ≥0.7 m in about 20% of the quasars, and it seems possible that optical "outbursts" occur in most active quasars, but usually are not detected due to their relatively short duration. In a recent "outburst" of 3C 345 a variation of ≈0.4 m was observed over a span of a few hours. (UK)

48660 UNIFIED MODEL FOR PULSARS. Chiu, Hong-yee (Goddard Space Flight Center, New York); Occhionero, Franco. Nature (London), 223: 1113-16(Sept. 13, 1969).

It is postulated that the action of a strong electric field on electrons at the surface of pulsars causes a population inversion, and a laser-type transition produces a continuous emission guided by the magnetic field into sharply defined beams. (auth) (UK)

48661 PULSATING STARS: A NATURE REPRINT. New York, Plenum Press, 1968. 102p.

Since the first report of the first discovery of pulsars (Nature 217: 709(1968)), astronomers and physicists have suggested several ways in which the pulsation might be explained. For the first six months after the discovery, most of the scientific literature on this subject appeared in Nature, and this volume includes a selection of the first fifty-one articles grouped as to discovery, signal characteristics, optical measurements, theories, and applications. Introductions are given by F. G. Smith and A. Hewish. (W.D.M.)

48662 BALLOON OBSERVATIONS OF HIGH-ENERGY X-RAY SOURCES IN THE REGION OF THE GALACTIC CENTRE. Lewin, W. H. G.; Clark, G. W.; Gerassimenko, M.; Smith, W. B. (Massachusetts Inst. of Tech., Cambridge). Nature (London), 223: 1142-3(Sept. 13, 1969).

Several x-ray sources in a region ear the galactic center were indicated in a balloon flight launched from Mildura, Australia, on Oct. 15, 1967, during which the x-ray emission above 20 keV was surveyed over the region of the sky from declinations −70 to −5° and from right ascensions 150 to 280°. By analysis of the data the bulk of the hard x rays could be accounted for in terms of four sources, the positions and spectra of which are reported. A map in galactic coordinates is presented showing the source positions; also shown are some of the data reported from rocket surveys, using narrow slit collimators. The spectra of the four sources are reproduced, and results compared with those of other workers. (UK)

48663 DECREASE OF FLUX DENSITY OF THE RADIO SOURCE CASSIOPEIA A AT 81.5 MHz. Scott, P. F.; Shakeshaft, J. R.; Smith, M. A. (Cavendish Lab., Cambridge, Eng.). Nature (London), 223: 1139-40(Sept. 13, 1969).

Some observations made in Nov. 1967, April 1968, and June 1969 are described which, together with the observations of Hoegbom and Shakeshaft (Nature, 189: 561 (1961)) made in 1956 and 1960, and combined with earlier observations by Ryle in 1948-9, provide information at 81.5 MHz over a span of 20 years. An interferometric radio telescope was used for the recent observations, each element consisting of one half of the long cylindrical parabolic reflector at the Mullard Radio Astronomy Observatory, Cambridge. The method employed involved a comparison of the intensities of the sources Cas A and Cyg A, thereby avoiding the difficulties inherent in absolute measurements, Cyg A being regarded as of constant flux density and used as reference standard. Data obtained by Parker (Mon. Not. Roy. Astron. Soc., 138: 407 (1968)) provided an accurate value of the relative intensities of the two sources in Nov. 1966. All observations showed a decrease of flux density for Cas A. The time scale was not long enough for any change of the rate of decrease to be revealed, but the annual rate of decrease was found to be $1.29 \pm 0.08\%$. The model proposed by Shklovsky (Astro. Zhur., 37: 256 (1960)) is discussed; this model predicts that the rate of change of flux density should be independent of frequency, which is borne out by results at 81.5 and 3,200 MHz. The results are of interest in connection with the theory of expanding radio sources, and in connection with determination of the gain of antennas used in satellite communications. (UK)

Solar Phenomena

Refer also to abstracts 48578, 48809, and 48909.

48664 (N-69-30870) RELATIVE HELIUM ABUNDANCE AND PLASMA PROPERTIES IN THE SOLAR WIND. Robbins, Donald Eugene (National Aeronautics and Space Administration, Houston, Tex. Manned Spacecraft Center). June 1969. 268p. (NASA-TM-X-58031). CFSTI.

Thesis. Submitted to Houston Univ., Tex.

Data obtained on the Vela 3A and 3B satellites between July 1965 and July 1967 were used in this study. The long-term average of the helium-to-hydrogen density ratio was 0.037. Of the 10,314 spectra used, 90% gave He−H ratios between 0.01 and 0.08. Comparisons with "solar surface" relative He abundance measurements were made. The He−H ratios observed were greater than 0.063 only 10% of the time. Mechanisms that allow regions of higher He abundance in the chromosphere and corona are discussed. Large variations of the He/H ratio were observed even when averages over solar rotations were computed. A possible solar-cycle dependence of the abundance is suggested. Sudden large increases in the He/H ratio correlate well with Forbush decreases and sudden commencement geomagnetic storms. Theories relating these increases to part of the solar chromosphere blown into the solar wind during flares are discussed. The He and H bulk velocities were found to be virtually equal at all times. The phenomena of "frozen in flux" is used to explain this equality. Solar-wind ion species were found to be rarely in thermodynamic equilibrium. The average He temperature was four times the H temperature, indicating that the two ion species have equal velocities. (auth) (STAR)

48665 HELIUM ABUNDANCE DETERMINATION FROM SOLAR-MODEL PHOTOSPHERES. Rouse, C. A. (Hulburt Center for Space Research, Washington, D. C. Univ. of California, Berkeley). Astron. Astrophys., 3: 122-5(Sept. 1969).

Preliminary results from a new method for determining the helium abundance of the Sun by the theoretical prediction of line and continuum radiation from solar-model photospheres are given. Using a solar-model photosphere (SMP) with assumed $He/H = 0.14$, the predicted residual intensities in the wings of the resonance line of Ca I(λ 4226.73 Å) and the K-line of Ca II (λ 3933.67 Å) and the predicted continuum intensities at λ = 4000 Å and 5000 Å are in good agreement with observations. On the other hand, an SMP with an assumed $He/H = 0.05$ predicts line profiles and continuum intensities significantly lower than observed. Therefore, since an SMP with He/H slightly less than 0.14 would predict line profiles in very good agreement with Houtgast's observations, and would also predict continuum intensities in very good agreement with the more widely accepted low observed values, it is concluded that the most probable solar helium relative mass abundance is slightly less than 0.35, with additional calculations in progress to set upper and lower limits. (auth)

48666 STUDY OF THE ABSORPTION SPECTRA OF THE $A^2\Pi - X^2\Sigma$ AND $B^2\Sigma - X^2\Sigma$ SYSTEMS IN CALCIUM HYDRIDE. Liberale, G.; Weniger, S. (Observatoire de Paris, Meudon, France). Physica, 41: 47-57(Feb. 21, 1969). (In French).

From International Conference on Laboratory Astrophysics, Lunteren, Netherlands. See CONF-680965.

The spectrum of this radical whose presence has been proved in sunspots and in dwarfs was obtained in absorption with a resistance graphite furnace. The observed development of the band structure permitted to prolong some main branches and to complete the satellite branches of the system $A^2\Pi - X^2\Sigma$. The curves of the intensity repartition in the bands (0,0) of the systems $B^2\Sigma - X^2\Sigma$ and $A^2\Pi - X^2\Sigma$ are shown. The "effective" rotation temperature, determined graphically, is in good agreement with the measured temperature. The astrophysical aspect of the laboratory researches in the spectra of CaH and Ca_2 is then discussed. (auth)

48667 INTENSITY ALTERNATIONS IN THE SECOND POSITIVE BANDS ($C^3\Pi_u - B^3\Pi_g$) OF $^{14}N_2$ AND $^{15}N_2$. Bleekrode, R. (Philips Research Labs., Eindhoven, Netherlands). Physica, 41: 24-6(Feb. 21, 1969).

From International Conference on Laboratory Astrophysics, Lunteren, Netherlands. See CONF-680965.

A spectroscopic study was made of intensity alternations which can be observed in the rotational fine structure of the second positive bands of N_2 if these are excited in mixtures of argon and nitrogen. A phenomenological description of this phenomenon is given, which leads to a predictable rotational intensity pattern in the bands if $^{15}N_2$ is used. The results obtained are in agreement with these predictions. (auth)

48668 COHERENT SYNCHROTRON DECELERATION AND THE EMISSION OF TYPE-II AND TYPE-III SOLAR RADIO BURSTS. Kuckes, A. F.; Sudan, R. N. (Cornell Univ., Ithaca, N. Y.). Nature (London), 223: 1048-9(Sept. 6, 1969).

Type-II and -III solar radio bursts are spectacular emissions that accompany the flash phase of a solar flare, and a widely accepted explanation of type-III bursts is that they are related to electrostatic plasma oscillations which are partially converted into transverse electromagnetic radiation by nonlinear processes. The present authors propose the somewhat different theory that the emissions are related to a plasma instability associated with the coherent synchrotron deceleration of electrons having energies of hundreds of keV; this gives a means for amplifying synchrotron radiation. Consideration is given to the resonant exchange of power between electromagnetic waves propagating normal to the magnetic field in a cold magnetized plasma with a group of mildly relativistic electrons. The basic mechanism by which energy is fed from the wave into the energetic particles, and vice versa, is closely related to the principle of dynamic phase stability which governs the acceleration of particles to relativistic energy in a synchrotron accelerator. Through the variation of cyclotron frequency with particle energy, resonantly interacting particles become phase synchronized by the electromagnetic wave by a small gain or loss of particle energy. If the number of particles that give up energy in becoming synchronized by the wave exceeds the number that gain energy from it, power is coherently fed into the electromagnetic field. If the gradient of the electron momentum distribution function with respect to the transverse component of the momentum is positive at a resonant energy, power will be fed into the electromagnetic field; if it is negative there is a net gain of energy by the particles and dissipation of the wave. The generation of harmonics is discussed, and estimates are made of the wave growth distance. This mechanism for the generation of solar radio bursts is interesting since laboratory experiments and calculations have shown that electrons in the hundred keV range can directly generate one or two harmonics of transverse electromagnetic radiation by a linear process which excludes the excitation of higher harmonics. The success of the theory depends on the magnitude of the magnetic field at the source of the bursts. (UK)

48669 THERMAL CONTINUUM RADIATION FROM CORONAL PLASMAS AT SOFT X-RAY WAVELENGTHS. Culhane, J. L. (Univ. College, London). Mon. Notic. Roy. Astron. Soc., 144: 375-89(1969).

The continuous spectra, arising from the free–free and free–bound transitions of electrons in coronal plasmas, are calculated for wavelengths in the range 1 to 30 Å and at temperatures in the range 0.8×10^6°K to 100.0×10^6°K. The effect of variations in the element abundances is investigated. Estimates of the continuum flux from the solar corona are presented and the observed line to continuum ratios discussed. (auth) (UK)

48670 THE DIFFERENCES BETWEEN QUIET AND ACTIVE REGIONS MEASURED BY SPECTROHELIOGRAMS IN THE NEUTRAL HELIUM RESONANCE LINES. Hearn, A. G.; Noyes, R. W.; Withbroe, G. L. (Harvard Coll. Observatory, Cambridge, Mass.). Mon. Notic. Roy. Astron. Soc., 144: 351-7(1969).

Spectroheliograms of the 537 and 584 Å lines of neutral helium were obtained in November 1967 by the Harvard spectroheliometer on OSO-IV. The increased intensities of these lines in active regions cannot be explained by an increased electron temperature. Calculations show that the variation of the ratio of the intensity of the 538 Å line to the 584 Å line as a function of the intensity of the 584 Å line is consistent with the layers emitting these lines having a higher electron density in the active regions. The calculations require the layer emitting the neutral helium lines in a quiet region to have an electron temperature of 32,000°K and an electron density of 4.5×10^{10} cm^{-3}. The error in this electron density may be a factor of 3. The active regions that have been observed require an increase in the electron density of up to 2.5 times that of a quiet region. (auth) (UK)

Galaxies

Refer also to abstracts 48639, 48646, and 48760.

48671 IC 3258, A SMALL EXTRAGALACTIC OBJECT WITH A BLUESHIFT. Burbidge, E. M.; Dempulin, M.-H. (Univ. of California, San Diego, La Jolla). Astrophys. J., 157: L155-6 (Sept. 1969).

Observations of IC 3258 show it to have an emission-line spectrum with a blueshift of –490 km sec^{-1}. If it is in the Virgo Cluster, it has a high velocity relative to the average for the cluster (it might possibly be a large gas cloud ejected from the radio galaxies M84 or M87). If it is a foreground galaxy, it is a low-luminosity dwarf with a large random velocity. (auth)

48672 ORIGIN OF THE MAGNETIC FIELD OF THE GALAXY. Parker, E. N. (Univ. of Chicago). Astrophys. J., 157: 1129-35(Sept. 1969).

A recent formal calculation demonstrates that the individual Fourier components of a magnetic field are stochastic variables when the field is carried in a random turbulent velocity $V_i(r,t)$. The individual Fourier components random-walk, with the result that their mean squares increase with time. The calculation is applicable to the Galaxy when the magnetic field is sufficiently weak ($B \lesssim 10^{-6}$ gauss). Application to the gaseous disk of the Galaxy indicates that a field of 10^{-6} gauss would be created in less than 10^9 years. The present orientation and large scale of the field along the galactic arm are presumably the result of the nonuniform rotation of the Galaxy. It is concluded that turbulence is the most powerful source of magnetic field in the Galaxy, and that the present galactic magnetic field is the result of such turbulence. (auth)

48673 THE BOWEN FLUORESCENCE MECHANISM IN PLANETARY NEBULAE AND THE NUCLEI OF SEYFERT GALAXIES. Weymann, Ray J.; Williams, Robert E. (Univ. of Arizona, Tucson). Astrophys. J., 157: 1201-13(Sept. 1969).

The efficiency of the Bowen fluorescence mechanism in models of planetary nebulae and the nuclei of Seyfert galaxies was calculated by using the Feautrier method to solve the equation of transfer for He II Ly-α and the Bowen lines. The calculated efficiencies, which do not show significant differences between planetary nebulae and Seyfert galaxies, range from about 40 to 50% for realistic models. These values are somewhat higher than those for recent empirical determinations of Bowen conversion in planetary nebulae. Certain discrepancies between theoretical and observed line ratios are noted, however, which make the comparison with observation ambiguous. The efficiencies are shown to be rather insensitive to changes in various parameters. It is also noted that observations do not necessarily show that the Bowen lines are systematically weaker in the nuclei of Seyfert galaxies than in planetary nebulae. (auth)

48674 FARADAY ROTATION, DISPERSION IN PULSAR SIGNALS, AND THE TURBULENT STRUCTURE OF THE GALAXY. Jokipii, J. R.; Lerche, I. (Univ. of Chicago). Astrophys. J., 157: 1137-45(Sept. 1969).

The mean and the variance about the mean of the Faraday rotation and signal dispersion for electromagnetic waves propagating in a turbulent medium such as the Galaxy were calculated. With regard to the electron number density and the magnetic field as homogeneous random functions (with nonzero mean), the results are presented in terms of the mean values and two-point correlation functions of these quantities. Application to a simple, statistically homogeneous, disk model of the Galaxy and its turbulence is then considered. The predictions of the model for the means and variances are consistent with the observed Faraday rotations and the dispersions in pulsar signals, although the observations are not yet sufficient to provide a definitive test of the theory. The mean values are much as those discussed by previous authors who did not consider the fluctuations. The variances of the Faraday rotations and the dispersions in pulsar signals are used to estimate statistical parameters such as the

correlation length and rms fluctuations associated with turbulence in the Galaxy. It is found that the correlation length L is approximately equal to the 250-pc thickness of the galactic disk. The average magnetic field is $\sim 3 \times 10^{-6}$ gauss, and its rms fluctuation is $\sim 1.5 \times 10^{-6}$ gauss. The average electron number density is $\sim 4 \times 10^{-2}$ cm^{-3}, and its rms fluctuation is $\sim 3 \times 10^{-2}$ cm^{-3}. (auth)

48675 OBSERVATIONS OF THE 21-CM HYDROGEN LINE TOWARD HIGH-LATITUDE STARS. Goldstein, S. J. Jr.; MacDonald, Delphine D. (Univ. of Virginia, Charlottesville). Astrophys. J., 157: 1101-18(Sept. 1969).

21-cm spectra were obtained in 213 positions toward early-type stars with galactic latitude numerically greater than 20° and declination greater than −40°. A velocity range of ±50 km sec^{-1} with respect to the local standard of rest was covered with a resolution of 1.3 km sec^{-1}, and in most cases a resolution of 0.53 km sec^{-1} was also used. The 140-foot telescope and the 101-channel autocorrelation function receiver of the National Radio Astronomy Observatory with a system-noise temperature of 200°K and 10-minute integrations were used. The velocities of 268 well-resolved features from these spectra are given. About half of the stars have published observations of interstellar calcium or sodium lines. It is found that most of Adams's velocity measurements for calcium lines agree to within 2.5 km sec^{-1} with the measurements in the same direction. However, there is little agreement between the hydrogen-line components and calcium-line components from the Adams or Münch and Zirin catalogs when the velocity with respect to the local standard of rest is 23 km sec^{-1} or more. The integrated brightness temperatures found from the 21-cm spectra are the basis for a study of the galactic gas layer near the Sun. On the assumption that the Sun is at the center of an optically thin layer, stratified parallel to the galactic equator, the observations give 2.5×10^{20} atoms per cm^2 for the projected density of hydrogen atoms. If the layer is allowed to have an arbitrary pole, the observations fit best when the galactic coordinates of the pole are l = 180°, b = 75°, a value that differs by 4° from the pole of the Gould's belt system obtained by Shapley. The projected density in this new coordinate system is 9.0×10^{19} atoms per cm^2. However, the concept of a stratified optically thin layer is at best a crude description of the local gas, for the rms deviation of an individual observation is 3.3 times the value which the best-fitting model predicts for the integrated brightness temperature at the pole. (auth)

48676 COLORS, LINEAR POLARIZATION, AND PRELIMINARY MAPPING OF THE MAGNETIC FIELD FOR THE OUTER FILAMENTS IN THE EXPLODING GALAXY M82. Sandage, Allan (Carnegie Institution of Washington, D. C. California Inst. of Tech., Pasadena. Australian National Univ., Canberra); Visvanathan, N. Astrophys. J., 157: 1065-74(Sept. 1969).

The surface brightness, colors, and linear polarization of selected regions in the outer filaments of M82 have been measured in optical wavelengths. The measured filaments are very faint, ranging in surface brightness from V = 22.4 to V = 25.0 mag per square second of arc. The (U − B, B − V) colors are much bluer than the main body of M82. Theoretical colors, calculated from a synchrotron spectrum that passes through the radio data and that extends into the optical region, generally agree with the observed colors to within $\Delta \log F(\nu) = \pm 0.03$ if the high-frequency cutoff is put between 4×10^{14} and 6×10^{14} Hz. Large linear polarization is present for each region and reaches a maximum value of 32% for patch J. The direction of the electric vector is perpendicular to the two main filaments on the north side of M82. The electric vectors form a somewhat less regular pattern on the south side, but agree sufficiently in direction to show that the magnetic field lies predominantly along the minor axis of M82 if the radiation is of synchrotron origin. The data support, but do not prove, the hypothesis that the large-scale filaments are emitting optical synchrotron radiation caused by relativistic electrons whose energies reach $\sim 4 \times 10^{12}$ eV if the average magnetic field strength is between 10^{-5} and 10^{-6} gauss. (auth)

48677 FLOW OF IONIZED GAS FROM A GLOBULE IN INTERSTELLAR SPACE. Kahn, F. D. (Univ. of Manchester, Eng.). Physica, 41: 172-89(Feb. 21, 1969).

From International Conference on Laboratory Astrophysics, Lunteren, Netherlands. See CONF-680965.

The flow of ionized gas from a globule in interstellar space illustrates rather well the various physical processes that often occur in or near ionization fronts. Thus the nonionized gas is largely shielded from the incident radiation by the H II region that forms around it. The low-frequency photons are absorbed more easily in this region so that the typical photon reaching the front has more than average energy, and the usual processes govern the thermal balance of the gas. In the case of a globule the front is strong D-type, so that it advances subsonically into the gas ahead of it, but the ionized gas streams away supersonically in the rear. The strong D condition provides one of the boundary conditions needed to define the flow; this conclusion is similar to one reached by Axford when he was studying the expansion of a spherically symmetrical H II region around a star. Finally, some estimates are made for the mass of gas likely to be contained in the globule, and of the condition for it to be stable against gravitational collapse. (auth)

48678 EXTINCTION BY INTERSTELLAR GRAINS, MIE PARTICLES, AND POLYCYCLIC AROMATIC MOLECULES. Donn, B.; Krishna Swamy, K. S. (Goddard Space Flight Center, Greenbelt, Md.). Physica, 41: 144-50(Feb. 21, 1969).

From International Conference on Laboratory Astrophysics, Lunteren, Netherlands. See CONF-680965.

Interstellar extinction has now been measured from 5 μ in the infrared to 0.12 μ in the ultraviolet. This large spectral interval permits a much more critical test of hypothetical interstellar particles than has previously been possible. A comparison of the observed extinction and that of proposed grain models is presented. (W.D.M.)

48679 INTERPRETATION OF THE DIFFUSE GALACTIC RADIATION. Van de Hulst, H. C.; De Jong, T. (Sterrewacht, Leiden). Physica, 41: 151-62(Feb. 21, 1969).

From International Conference on Laboratory Astrophysics, Lunteren, Netherlands. See CONF-680965.

Witt's observations of the diffuse galactic radiation are reinterpreted by solving the same transfer problem exactly, instead of using Eddington's approximation. A range of combinations of a (albedo) and g (anisotropy factor) of the single scattering diagram fits the data. This result does not depart greatly from the conclusion reached by Henyey and Greenstein in 1941. Platt particles and graphite flakes seem to be ruled out. (auth)

48680 SPECTRA OF IMPURITIES IN INTERSTELLAR GRAINS. Duley, W. W. (York Univ., Toronto). Physica, 41: 134-6(Feb. 21, 1969).

From International Conference on Laboratory Astrophysics, Lunteren, Netherlands. See CONF-680965.

The possibility that the diffuse interstellar absorption bands may be due to resonance lines of impurity atoms trapped in low temperature hydrocarbon matrices is examined. Reference is made to the spectrum of Na atoms in solid C_6H_6 at temperatures below 100°K. Comparison of these spectral features to the diffuse bands at 5780.6 Å and 5797.1 Å is made. Evidence for vibronic structure in the diffuse interstellar band system is discussed. (auth)

48681 SOME IDEAS ON THE DISTRIBUTION OF INTERSTELLAR DUST. Loden, L. O. (Stockholm Observatory, Saltsjoebaden, Sweden). Physica, 41: 137-8(Feb. 21, 1969).

From International Conference on Laboratory Astrophysics, Lunteren, Netherlands. See CONF-680965.

A suggestion to explain an observed variability in starlight polarization and similar phenomena is discussed. (auth)

48682 ELECTRONOGRAPHIC STUDY OF THE INTERSTELLAR 4430 BAND. Brueck, M. T.; Nandy, K.; Seddon, H. (Royal Observatory, Edinburgh). Physica, 41: 128-33(Feb. 21, 1969).

From International Conference on Laboratory Astrophysics, Lunteren, Netherlands. See CONF-680965.

Asymmetric profiles of the 4430 interstellar absorption band were obtained by independent methods. The first, by differencing spectra of stars of the same spectral type but different interstellar absorptions, shows a profile steeper to the red. The second, by computer reduction of electronographic spectra, shows the same feature, but also an apparent emission wing to the blue of the normal 4430 profile. It is pointed out that this can lead to a possible interpretation of the cause of the interstellar bands. (auth)

48683 ON THE ALIGNMENT OF INTERSTELLAR DUST. Purcell, E. M. (Harvard Univ., Cambridge, Mass.). Physica, 41: 100-27(Feb. 21, 1969).

From International Conference on Laboratory Astrophysics, Lunteren, Netherlands. See CONF-680965.

Two alignment mechanisms have been investigated by means of a Monte Carlo model. In the mechanism suggested by Gold, needles or flakes which have a sufficiently high velocity with respect to the gas around them are aligned in consequence of the anisotropy of the angular momentum acquired by a grain in collision with gas atoms. Spheroids exhibited, in the Monte Carlo runs, the expected alignment. The quantitative dependence of both angular momentum alignment and axis alignment on grain shape and velocity has been established with an accuracy of 5 to 10%.

The maintenance of grain velocity by radiation pressure and the effect of a magnetic constraint on the trajectory of a charged grain are discussed. With paramagnetic relaxation incorporated, for Monte Carlo model exhibits Davis–Greenstein alignment. The results for different grain shapes, grain temperatures, and magnetic viscosities are compared with the theoretical predictions of Jones and Spitzer. Because the low-frequency magnetic viscosity in any paramagnetic system with dipole–dipole coupling only is independent of the dipole strength and concentration, protons are as effective as electrons. The viscosity arising from diamagnetic relaxation in graphite is estimated to be much too small for effective alignment of graphite flakes. (auth)

48684 INTERSTELLAR POLARIZATION AND GALACTIC MAGNETIC FIELD STRENGTHS. Greenberg, J. M. (Rensselaer Polytechnic Inst., Troy, N. Y.). Physica, 41: 67-91(Feb. 21, 1969).

From International Conference on Laboratory Astrophysics, Lunteren, Netherlands. See CONF-680965.

The maximum observed ratio of polarization to extinction is used as a criterion to attempt to make a choice among models of interstellar clouds consisting of grains of (1) dirty ice, (2) graphite, and (3),graphite flakes with dirty ice mantles. The optical scattering properties for the appropriate nonspherical particles are obtained either from exact theory or from microwave analog measurements. The magnetic properties of the grains and the orientation mechanism are treated with as much detail and accuracy as seems useful and feasible at present. The required magnetic field strength is generally greater than 10×10^{-6} gauss. However, under rather reasonable conditions, the magnetic field requirement for the dielectric grains may be reduced to 6×10^{-6} gauss for very high ratio of polarization to extinction, and for moderate ratios the field requirement is reduced to less than 4×10^{-6} gauss. On an overall basis the models are satisfactory in the order (1), (3), (2) although the difference between (1) and (3) is not large. The effect of grain and gas temperature is discussed and a possible criterion is presented for distinguishing between the three models based on different interactions with the ambient gas and radiation field. (auth)

48685 EXTINCTION IN THE FAR ULTRAVIOLET. Greenberg, J. M.; Shah, G. A. (Rensselaer Polytechnic Inst., Troy, N. Y.). Physica, 41: 92-9(Feb. 21, 1969).

From International Conference on Laboratory Astrophysics, Lunteren, Netherlands. See CONF-680965.

The model of interstellar grains consisting of an appropriate size distribution of elongated dielectric particles represented by infinite circular cylinders is shown to reproduce the observed interstellar extinction through the spectral range from the infrared to the far-ultraviolet. It is shown that this model gives at least as good a match with observation as any which have been obtained with graphite core–dielectric mantle particles. It is also shown that if the dielectric material in either model is optically like "dirty ice," then there is a drop in the theoretical extinction curves at wavelengths beyond $\lambda^{-1} = 5$ to $6\,\mu^{-1}$. (auth)

48686 BRIGHTEST MEMBERS OF CLUSTERS OF GALAXIES. Peach, J. V. (Oxford Univ.). Nature (London), 223: 1140-2 (Sept. 13, 1969).

The small dispersion in the absolute magnitude of the brightest member of rich clusters of galaxies was interpreted by Peebles (Astrophys. J., 153: 13(1968)) in terms of a statistical model based on a luminosity function common to all clusters, and Peebles concluded that observations were compatible with predictions of the model. The brightest galaxies in clusters would thus obey a statistical luminosity function smoothly extrapolated from the fainter members, and there would be nothing physically remarkable about their small luminosity dispersion. Difficulties with regard to this statistical theory are discussed, and it is concluded that the theory is inadequate, and it would not appear possible to account for the luminosity of the brightest member of a cluster by a luminosity function observationally defined by the fainter cluster members. Observations are compatible with the conclusion that the magnitude of the brightest member is a normally distributed random variable, independent of cluster richness or the luminosity function governing the fainter members. Such a conclusion is of importance for theories of galaxy formation, and if the apparent absence of correlation between absolute magnitude and cluster richness is confirmed it would be of significance in the use of the brightest cluster members as cosmological test objects. (UK)

48687 MILLIMETRE WAVE EMISSION BY INTERSTELLAR DUST. Litvak, M. M. (Massachusetts Inst. of Tech., Lexington). Nature (London), 223: 1143-4(Sept. 13, 1969).

It is postulated that if interstellar grains consist of semiconductor-like material with a dc conductivity in the range 0.01 to 10 Ω^{-1} cm^{-1}, then there may be large optical depths for millimeter and sub-millimeter waves due to the grains, and dense clouds or condensations within them may be significant blackbody radiators at these wavelengths because of the grains. Since the grains may have amorphous but not glassy structure, or contain impurities and lattice defects even if the structure is well ordered, such conductivities are highly probable. It is pointed out that the conductivity probably depends exponentially on the temperature because of the ionization potential of shallow impurity states. Under the assumed conditions, the emission maximum in QI for semiconductor grains occurs in the millimeter region. Conductivities >10 Ω^{-1} cm^{-1} are also possible. The carrier concentration might increase considerably when the temperature is sufficiently high to ionize less shallow donor or acceptor levels or to excite electrons across a small semiconductor energy gap, leading to the submillimeter range. (UK)

Cosmology

Refer also to abstract 49206.

48688 PRIMEVAL GLOBULAR CLUSTERS. II. Peebles, P. J. E. (California Inst. of Tech., Pasadena). Astrophys. J., 157: 1075-83(Sept. 1969).

The time variation of initially isothermal perturbations is computed numerically through the epoch of recombination of the primeval plasma. The mean mass of the primeval gas clouds, tentatively identified as proto-globular clusters, is computed for a range of possible choices of the parameters in the theory. (auth)

48689 THE EVOLUTION OF ANISOTROPY IN NONROTATING BIANCHI TYPE-V COSMOLOGIES. Matzner, Richard A. (Univ. of Texas, Austin). Contract F33615-68-C-1675. Astrophys. J., 157: 1085-1100(Sept. 1969).

The effect of neutrino viscosity and of free neutrinos in universes of Bianchi types I and V are considered and the collisionless Boltzmann equation (which gives the evolution of the neutrino-distribution function) for these types are discussed and the type V results with those for type I previously given by Misner are compared. It is assumed that dissipative effects lower ρ_β/ρ (the ratio of the anisotropy energy density to the matter energy density, both measured by their gravitational effect on the expansion) to a number of order unity before the electron neutrinos become collisionless. The null geodesics cannot be completely integrated in type V, so a complete numerical example of the dynamics of the model with collisionless radiation cannot be presented. An approximate model universe of type V which begins its free evolution with $\rho\beta = \rho$ at a temperature of $\sim 10^{10}$°K is presented. The approximation lies in an assumption of small β for the subsequent motion (where β is a parameter describing the anisotropy). This model predicts $\Delta T/T \sim 2 \times 10^{-4}$ for the variation in the primordial radiation temperature, if one assumes a switchover from radiation domination to matter domination at T ~ 300°K. This variation $\Delta T/T$ is of the same order as that found previously for type I and type IX by Misner. There is, however, a new feature, since there is an asymmetry (in the strength of the anisotropy) between opposite hemispheres. Depending on the current relative sizes of ρ_m (the matter density) and R* (the 3-space curvature), this asymmetry can be quite strong. An estimate taking parameters consistent with current observations suggests an excess of <5 to 10 in the amplitude of the anisotropy in the hemisphere $\theta > \pi/2$, compared with the hemisphere $\theta < \pi/2$, for the epoch when $\rho_m^{-1} R^* \sim 1$. (The current epoch has $\rho_m^{-1} R^* \gtrsim 1$.) (auth)

48690 LIMITS ON THE COSMOLOGICAL DECELERATION PARAMETER. Rindler, Wolfgang (Southwest Center for Advanced Studies, Dallas). Astrophys. J., 157: L147-50(Sept. 1969).

For zero-pressure, big-bang Friedmann models of the cosmos it is shown that the known upper limit of σ_0 and the known lower limits of H_0 and t_0 impose, respectively, lower and upper limits on q_0, namely, $-10.1 < q_0 < +5.0$. These, in turn, delimit the values of Λ and k/R_0^2. (auth)

48691 POSSIBILITY OF EXISTENCE OF A DENSE INTERGALACTIC PLASMA. Bergeron, J. (Institut d'Astrophysique, Paris). Astron. Astrophys., 3: 42-56(Sept. 1969). (In French).

The implication of the existence of a dense, hot, intergalactic plasma is discussed for Friedman universes with a zero cosmological constant. The points of interest are the temperature of the intergalactic gas and the degree of ionization of its constituents. The most important observations to test the validity of the model are the isotropic x-ray emission around 3 keV and around 0.27 keV, and the lack of Lyman α absorption in the emission spectra of the QSO's. The intergalactic gas is assumed to be 90% hydrogen and 10% helium. The model assumes that the intergalactic medium is heated, and that the heating occupies a time short compared to the lifetime of the Universe. (TSS)

48692 SINGULAR DOMAINS OF SPACE. Hajicek, Petr (Inst. of Theoretical Physics, Berne). Helv. Phys. Acta, 42: 808-12(1969).

A generalization of a definition of cosmological singularity is proposed which allows to formulate singularity theorems so that they refer only to a finite domain of space–time. In this way, two theorems due to Hawking are sharpened, by means of which it can be shown that the Universe cannot be singularity free, unless the causal loops violating the strong causality required by Hawking lie entirely in an explicitly indicated compact region of the past. (auth)

48693 AXIALLY SYMMETRIC HOT BIG-BANG COSMOLOGIES. Carswell, R. F. (Univ. of Sussex, Brighton, Eng.). Mon. Notic. Roy. Astron. Soc., 144: 279-96(1969).

An analysis of homogeneous axially symmetric anisotropic cosmological models containing radiation, matter, and a uniform magnetic field is given. The results obtained are used to discuss the effect of magnetic fields and initial anisotropies on the isotropy of the 3°K background radiation and on the primordial helium production. It is shown that some anisotropic models with a small present-day magnetic field and small microwave background anisotropy could have produced as little as about 5% ^{4}He by mass in the early stages of their evolution. (auth) (UK)

48694 SMALL-SCALE VARIATIONS IN THE COSMIC MICROWAVE BACKGROUND. Dautcourt, G. (Babelsberg Observatory, Berlin). Mon. Notic Roy. Astron. Soc., 144: 255-78(1969).

A discussion is given of some processes which produce fluctuations in the 3°K radiation on a small angular scale (≤1°). Apart from fluctuations caused by a primordial spectrum of spatial inhomogeneities in the matter and radiation densities, effects of scattering on the gravitational fields of clusters of galaxies as well as scattering by gravitational radiation of extremely large coherence or wavelengths are considered. While scattering by static gravitational field perturbations may be neglected in most cases, scattering by gravitational radiation with large wavelengths may produce variations on an observable level. The measurements by Conklin & Bracewell (1967) provide upper limits on the equivalent mass density of a gravitational radiation background for coherence lengths L > 1 Mpc. The fluctuations may be strongly affected by electron scattering in ionized intergalactic matter. (auth) (UK)

48695 HOW IMPORTANT IS STEADY-STATE COSMOLOGY TO CLASSICAL AND QUANTUM ELECTRODYNAMICS. Leiter, D. J. (Boston Coll., Chestnut Hill, Mass.). Nature (London), 223: 1145-6(Sept. 13, 1969).

Reference is made to a paper by Hoyle and Narlikar (Nature, 219: 340(1968)) on cosmology and electrodynamics, in which it is argued that the direct action electrodynamics of Wheeler and Feynman (Rev. Mod. Phys., 17: 157(1945) and 21: 425(1949)) may be used as evidence that the steady-state model is the correct form of cosmology in the physical Universe. It is pointed that a more consistent form of electrodynamics exists, based on the paradigm that, in a physical event, it is the mutual measurement interaction between the observer charge and the observed charge which is the basic elementary building block (Leiter, Ann. Phys., 51: 561(1969)). Within the context of a relativistic theory of point charges, this new theory implies that the charged particles and their electromagnetic fields are not elementary in themselves but are merely interdependent degrees of freedom in a scalar elementary measurement field. No free uncoupled electromagnetic fields will exist in the theory, implying that radiation occurs as the by-product of the propagation of mutual electromagnetic measurement interactions between charged particles and will not be independent of the detector. All self-measurement fields are excluded as being nonphysical, and the problem of infinite self-energies is also excluded. A consistent set of energy–momentum and angular momentum conservation laws follows from an associated conserved energy-momentum tensor. Because this theory can reproduce the Lorentz–Dirac equation for point charges, it can reproduce all the physical predictions of the Maxwell–Lorentz theory and the Wheeler–Feynman theory, but in a consistent fashion and with fewer assumptions. The new theory can also predict the same results concerning spontaneous transitions as the Hoyle–Narlikar quantum electrodynamics. It is concluded that classical elementary measurement electrodynamics, and its quantum generalization, may exhibit a dependence on cosmology when inserted into a general relativistic framework. It does not require the steady-state cosmological model for its internal consistency, and it is concluded that Hoyle and Narlikar's argument that a consistent local electrodynamics does require the steady state cosmology is not on firm ground. Comments by Hoyle and Narlikar are appended. (UK)

48696 ON THE ROLE OF NEUTRINO DENSITY IN A CLOSED EXPANDING UNIVERSE. Agnese, Angelo; La Camera, Mario; Wataghin, Andrea. Atti Accad. Naz. Lincei, Rend., Cl. Sci. Fis., Mat. Natur., 45: 323-5(Nov. 1968).

The simplest way of making possible a radiation closed model of the Universe is to advance the hypothesis that the dominating radiation responsible for the term ρ (radiation density) could be composed of neutrinos and antineutrinos. A system composed of these particles behaves as radiation. The model predicts that after 150 billion years the Universe will enter a matter era. (W.D.M.)

48697 RECENT PROGRESS IN COSMOLOGY: ISOTROPY OF THE 3^0 BACKGROUND RADIATION, AND THE OCCURRENCE OF SPACE–TIME SINGULARITIES. Kundt, Wolfgang (Univ., Hamburg). Ergeb. Exakten Naturwiss., 47: 111-42(1968).

During the past three years, theory and experiment in cosmology have largely linked up. Results are the necessity of a "big-bang" origin of time and a detailed understanding of the history of our universe. A survey is presented of the observational data, the theoretical tools for making "postdictions," and the cosmological model which has evolved from them. (auth)

Atomic and Molecular Physics

Atomic, Electron, Ion, and Molecular Beams and Their Reactions

Refer also to abstracts 47910, 48964, 48980, and 49245.

48698 (CONF-690805-3) DOSE-DEPTH DISTRIBUTIONS PRODUCED BY ELECTRONS IN MULTILAYER TARGETS. Kniedler, Marcel J.; Silverman, Joseph (Maryland Univ., College Park. Lab. for Radiation and Polymer Science). [1968]. 27p. Dep. CFSTI.

From Symposium on Utilization of Large Radiation Sources and Accelerators in Industrial Processing, Munich, Germany.

A series of practical problems involving the use of electron-beam and beta sources for radiation processing applications was studied. Monte Carlo computations were performed to determine the energy absorption, reflection, and transmission for the following configurations: plane parallel source of monoenergetic electrons incident on one face of a slab of a multilayered target; planar and line sources incident on cylindrical targets. The slab calculations were performed as a function of target composition (water, iron, and polyethylene), thickness of the individual layers, electron energy (0.1, 1.0, and 10.0 MeV), and angle of incidence between the electrons and the normal to the slab (0, 30, 60, and 90°). The cylindrical calculations were performed on finite and infinite cylinders. The method used is similar to the one employed in calculations of dose-depth curves in semi-infinite slabs. It takes into account energy losses from collisions with atomic electrons based on the continuous slowing-down model; it assumes a net angular deflection at the end of each selected path length on the basis of the multiple scattering elastic theory of Goudsmit and Saunderson (Goudsmit, S. and J. L. Saunderson, Phys. Rev., 57, 24(1940)); and it employs a mean bremsstrahlung energy loss over each path length. The principal information derived from the study is the distribution of energy dissipated within the target as a function of position for target systems of practical interest to the radiation processor and principles for the most efficient utilization of electron-beam sources. (auth)

48699 (KFK-962) PRODUCTION OF A POLARIZED DEUTERON BEAM FROM HYDROGEN ATOMS IN METASTABLE S_k CONDITION. Brueckmann, H.; Finken, D.; Friedrich, L.; Hamdi, K.; Seitz, E.; Ziegler, P. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Experimentelle Kernphysik). Apr. 1969. 16p. (In German). (CONF-690326-1). Dep. CFSTI (U.S. Sales Only).

From Spring Conference of the Committee on Nuclear Physics of the German Physical Society, Freudenstadt, Germany.

For the production of polarized hydrogen or deuterium ions beams a method that makes use of the different lifetimes of the metastable ^2S_k state and the ^2P_k state of the hydrogen atom (Lamb-shift source) was studied. This method has the advantage of producing intense negative ion beams having a high density of particles in the phase-space volume. A tensor polarization of $P_{33} = -0.70 \pm 0.01$ was achieved by the use of static magnetic fields. The tensor polarization was obtained by neutron asymmetry measurement with the T(d,n)^{4}He reaction. The polarization can be predicted from the experimental values for the ion beam intensities. Investigations of the beam emittance and acceptance were carried out to optimize the ion optic of the primary proton or deuteron beam. With an improved electrostatic lens system

a beam intensity of 150 nA negative deuteron ions was achieved. Polarized positive deuteron beams were produced by charge exchange of polarized metastable D(2S) atoms with hydrogen, deuterium, and helium. The quenching rate was investigated as a function of beam energy. For the positive and negative ions the polarization decreases slowly with the energy for all investigated charge-exchange reactions. (auth)

48700 KATODNOE RASPYLENIE. (Cathodic Sputtering). Pleshivtsev, N. V. Moscow, Atomizdat, 1968. 344p.

A brief review is given of the up to date data on experimental and theoretical studies on cathode sputtering and on the means of preventing the phenomena which produce undesirable results. Methods of investigating characteristics of sputtered particles, effects of various factors on the coefficient of crystal sputtering, sputtering of monocrystals in ion interactions with solids, photocathodes, sputtering of thoriated and film cathodes, sputtering of charged particles in accelerators and thermonuclear installation, and elimination of ion bombardment are discussed. 742 references. (R.V.J.)

48701 ELECTRON-INDUCED CASCADE SHOWERS IN WATER AND ALUMINUM. Crannell, Carol Jo (Catholic Univ. of America, Washington, D. C.); Crannell, Hall; Whitney, Randy R.; Zeman, H. D. Contracts Nonr 225(67); N00014-67-A-0377-0002. Phys. Rev., 184: 426-31(Aug. 10, 1969).

The three-dimensional distribution of energy deposition was measured for 1-GeV electron-induced showers in water and aluminum. For the water target, two different detectors were employed: CsI(Tl) and anthracene. The measured longitudinal distribution of energy in water was found to be essentially independent of the detector employed in the measurement, while the radial distribution of energy deposition shows a strong detector dependence. Data were measured for the aluminum target with a CaF_2(Eu) detector. All of these data support the description that the primary energy-deposition mechanism at the initiation of the shower is ionization of the target material, and that the principal energy-transport mechanism after shower maximum is the propagation of minimum-attenuation γ rays. The radial distributions of energy deposition show that the apparent dependence on the atomic number of the target observed in an earlier experiment was in part a detector-dependent result. The radial distributions nevertheless show significant differences from the prediction based on the Monte Carlo calculations of Nagel. (auth)

48702 RAMSAUER EFFECT FOR URANIUM ATOMS. Kudrin, L. P.; Dozorov, A. A. At. Energ. (USSR), 27: 39-41 (July 1969). (In Russian).

An approximate solution to the problem of elastic scattering of low-energy electrons on uranium atoms is given. The approximation is due to the choice of models for the electron–atom interaction. By means of numerical solution to the Schrödinger equation the elastic-scattering cross section is obtained for electron energies from 0.0085 to 36 eV. This calculation indicates a possibility of a well defined Ramsauer effect for uranium atoms in the region $E < 1$ eV. The calculational procedure was checked by solution of a similar problem for argon atoms. The results are in good agreement with experiment. 10 references. (auth)

48703 THRESHOLD REACTIONS IN THE FORMATION OF ION–DIPOLE PAIRS AS A METHOD OF OBTAINING MONOENERGETIC POLARIZED MOLECULAR BEAMS. Baz, A. I.; Gol'danskii, V. I. (Inst. of Chemical Physics, Moscow. Inst. of Atomic Energy, Moscow). Dokl. Akad. Nauk SSSR, 186: 1110-3(July 11, 1969). (In Russian).

Assume that the following reaction takes place: $A + B \rightarrow I + D$. Here I is a positive or negative ion, and D is a molecule having a dipole electric moment d. The nature of the colliding particles A and B is not of importance. The important point in this reaction is the strong long-range interaction of the dipole d with the electric field of the ions I to give a monoenergetic polarized dipole molecular beam. The interaction between the particles I and D is the main interaction in this case. Thus, on bombarding chlorine gas with Na^+ ions having an energy from 8.1 to 15 eV, oriented molecules of NaCl will be formed with energies varying from zero to about 8.5 eV. The interaction of these molecules with different targets or with crossed beams can be followed. (TTT)

48704 TOTAL ATOMIC PHOTOELECTRIC CROSS SECTIONS. Parthasaradhi, K.; Ramamurty, S. (Andhra Univ., Waltair, India). Nuovo Cim., 63B: 428-34(Sept. 11, 1969).

Total atomic photoelectric cross sections were obtained by the subtraction technique for the elements Cu, Mo, Ag, Sn, W, Au, Pb, and U in the energy region 20 to 1330 keV; results were compared with the tabulated theoretical predictions of Schmickley and Pratt. It was found that, in general, there is satisfactory agreement between the two. For the elements W, Au, and Pb, at energies just below the K-edge, there is a discrepancy of more than 5% between experiment and theory. (auth)

48705 ENERGY LOSS OF ELECTRONS PASSING THROUGH VARIOUS FOILS. Chung, Won Mo; Yoon, Gab Dong (Yonsei Univ., Seoul). J. Nucl. Sci. (Seoul), 9: 1-8(1969). (In Korean).

Beta particles from ^{137}Cs were used for measurements of energy losses in various foils. The initial and final momentum spectra were determined by a Yonsei-I three-quadrant, double-focusing, beta-ray spectrometer having a resolving power of 0.08%. The most probable energy loss in a number of foils as a function of foil thickness is shown in graphs for an energy of 624 keV. The data are compared with several theoretical expressions; the most probable energy loss is found to be reasonable. (auth)

48706 ENERGY-LOSS MEASUREMENTS ON III–V COMPOUNDS. Festenberg, C. v. (Univ., Hamburg). Z. Phys., 227: 453-81(1969). (In German).

Energy-loss measurements with 55-keV electrons were made on the III–V compounds GaP, GaAs, GaSb, InAs, and InSb. Retardation effects become important, because for these substances the condition for Čerenkov radiation is fulfilled. These produce an additional peak in the energy-loss spectrum; its angular distribution and its dependence on the foil thickness were measured. The experimental results are in good agreement with the energy-loss probability calculated by Kröger taking into account the retardation. Retardation and surface effects vanish for scattering angles $\vartheta \geq 0.6$ mradian. Then it is possible to determine the energy-loss function $\mathrm{Im}(1/\epsilon)$. By means of the Kramers–Kronig analysis the optical constants ϵ_1 and ϵ_2 were computed. The values are in agreement with data obtained from optical measurements. (auth)

48707 LOW-ENERGY, HIGH-ANGLE ELECTRON-IMPACT SPECTROMETRY. Kuppermann, Aron; Rice, J. K.; Trajmar, Sandor (California Inst. of Tech., Pasadena). J. Phys. Chem., 72: 3894-903(Oct. 1968).

A double electrostatic analyzer electron-impact spectrometer capable of obtaining energy loss spectra of molecules as a function of scattering angle and impact energies was constructed. It was used to investigate the differential scattering cross sections for optically allowed and forbidden transitions in several atoms and molecules for electron-impact energies from 25 to 60 eV and scattering angles from 0 to 80°. The results obtained for helium, hydrogen, nitrogen, carbon monoxide, and acetylene are summarized. In general, the intensity of a spin-forbidden transition, relative to that of an optically allowed one, is enhanced by about two orders of magnitude as the scattering angle increases from 0 to 80°. This rule is useful in identifying unknown singlet → triplet transitions. (auth)

48708 DISTRIBUTION OF ELECTRONS AFTER PASSING THROUGH THE THICK SAMPLES. Gusev, E. A.; Kononov, B. A. (Tomsk Polytechnic Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz., No. 7, 51-4(1969). (In Russian).

Angular distributions were determined for electrons with initial energy of 6.74 MeV, after penetrating C, Al, Sn, and Pb at specimen thicknesses that could be described by the theory of multiple scattering. Corrections are given for the loss of energy, multiple scattering, and scattering at large angles. (R.V.J.)

48709 THE ENERGY LOSS OF ELECTRONS PASSING THROUGH THIN CRYSTALS. I. Kamiya, Yoshihiro (Nagoya Univ., Japan). J. Phys. Soc. Jap., 27: 956-62(Oct. 1969).

The energy-loss spectra of electrons at the accelerating voltage 100 ~ 500 kV are measured for MgO single crystals. The most probable energy loss depends on the orientation of the crystal to the incident beam. The most probable energy loss at the Bragg reflecting position is less than that at other diffraction conditions. The energy loss in crystals about 5 μm thick is less than that expected by the Landau theory. (auth)

48710 CONVOLUTION EFFECTS IN ELECTRON ENERGY-LOSS SPECTRA RECORDED BY ELECTRON TRANSMISSION. Burge, R. E.; Misell, D. L. (London Univ.). J. Phys., C, 2: 1397-1404(Aug. 1969).

A general procedure was devised for the analysis and prediction of electron energy-loss spectra, which may be described in terms of two basic inelastic scattering processes, one being more probable than the other. The procedure is illustrated by its application to the analysis of the characteristic energy-loss spectra of evaporated Al films as seen by electron transmission. The procedure accounts for plural surface–volume and volume–volume scattering and the modifying effect of the finite resolution of the energy analyzer. Good agreement is found between observed and calculated spectra (23- to 70-keV energy electrons) for energy losses less than about 70 eV. The method allows the determination of the energy-loss distribution corresponding to a single-volume loss and provides a basis for estimating the importance of energy-loss

processes not specifically accounted for in the fitting procedure. (auth) (UK)

48711 THEORY OF SPUTTERING. I. SPUTTERING YIELD OF AMORPHOUS AND POLYCRYSTALLINE TARGETS. Sigmund, Peter (Argonne National Lab., Ill.). Phys. Rev., 184: 383-416(Aug. 10, 1969).

Sputtering of a target by energetic ions or recoil atoms is assumed to result from cascades of atomic collisions. The sputtering yield is calculated under the assumption of random slowing down in an infinite medium. An integro-differential equation for the yield is developed from the general Boltzmann transport equation. Input quantities are the cross sections for ion-target and target-target collisions, and atomic binding energies. Solutions of the integral equation are given that are asymptotically exact in the limit of high ion energy as compared to atomic binding energies. Two main stages of the collision cascade have to be distinguished: first, the slowing down of the primary ion and all recoiling atoms that have comparable energies — these particles determine the spatial extent of the cascade; second, the creation and slowing down of low-energy recoils that constitute the major part of all atoms set in motion. The separation between the two stages is essentially complete in the limit of high ion energy, as far as the calculation of the sputtering yield is concerned. High-energy collisions are characterized by Thomas-Fermi-type cross sections, while a Born-Mayer-type cross section is applied in the low-energy region. Electronic stopping is included when necessary. The separation of the cascade into two distinct stages has the consequence that two characteristic depths are important for the qualitative understanding of the sputtering process. First, the scattering events that eventually lead to sputtering take place within a certain layer near the surface, the thickness of which depends on ion mass and energy and on ion-target geometry. In the elastic collision region, this thickness is a sizable fraction of the ion range. Second, the majority of sputtered particles originate from a very thin surface layer (~5 Å), because small energies dominate. The general sputtering-yield formula is applied to specific situations that are of interest for comparison with experiment. These include backsputtering of thick targets by ion beams at perpendicular and oblique incidence and ion energies above ~100 eV, transmission sputtering of thin foils, sputtering by recoil atoms from α-active atoms distributed homogeneously or inhomogeneously in a thick target, sputtering of fissionable specimens by fission fragments, and sputtering of specimens that are irradiated in the core of a reactor or bombarded with a neutron beam. There is good agreement with experimental results on polycrystalline targets within the estimated accuracy of the data and the input parameters entering the theory. There is no need for adjustable parameters in the usual sense, but specific experimental setups are discussed that allow independent checks or accurate determination of some input quantities. (auth)

48712 VACUUM-ULTRAVIOLET PHOTON PRODUCTION IN LOW-ENERGY COLLISIONS BETWEEN TWO NEUTRAL ARGON ATOMS. Haugsjaa, Paul O.; Amme, C. (Univ. of Denver). Phys. Rev. Lett., 23: 633-5(Sept. 22, 1969).

The first observation of extreme-ultraviolet photons produced during collisions between two ground-state neutral argon atoms is described. The energy dependence of the relative cross section for photon production is found to exhibit structure at about 70-eV cms energy, similar to that observed in the cross section for ionization in argon collisions. (auth)

48713 ENERGY ANALYSIS OF ELECTRONS EJECTED IN SLOW ION-ATOM COLLISIONS. Gerber, G.; Morgenstern, R.; Niehaus, A. (Univ., Freiburg i. B.). Phys. Rev. Lett., 23: 511-13(Sept. 8, 1969).

Measured energy spectra of electrons ejected in collisions of Ar^+ ions with Ar at laboratory kinetic energies from 0.2 to 3 keV consist of a low-energy part, from 0 to ~9 eV, showing weak oscillatory structure, and a high-energy part, from ~9 to ~16 eV, showing pronounced peaks. These peaks can be explained by autoionization processes of superexcited Ar in the states ... $3s^23p^64sns$,np and ... $3s^23p^64sns$,np. (auth)

48714 SCATTERING OF 0.05- TO 5-eV ARGON FROM THE (111) PLANE OF SILVER. Romney, Michael J.; Anderson, James B. (Princeton Univ., N. J.). J. Chem. Phys., 51: 2490-6 (Sept. 15, 1969).

The scattering of atomic beams of argon from the (111) plane of silver was measured for incident energies in the range of 0.05 to 5 eV. Nearly monoenergetic beams were produced by the use of nozzle sources with pure argon and mixtures of argon with helium or hydrogen. Epitaxially grown crystal surfaces were obtained by vapor deposition of silver on mica. The observed scattering patterns were single lobes with the maxima lying near the specular angle at all energies. Results were similar to those of Smith, Saltsburg, and Palmer at energies below 0.3 eV with the maxima shifting toward the tangent to the surface with increasing energy. At higher energies the maxima were observed to shift back toward the normal as predicted by the theoretical calculations by Oman. Comparison of results with the simple hard- and soft-cube models for scattering indicates limitations of these models at hyperthermal energies. (auth)

Atomic and Molecular Properties

Refer also to abstracts 48587 and 48667.

48715 (ANU-P-468) STARK EFFECT IN He II AND H. Bashkin, S.; Carriveau, G. W. (Australian National Univ., Canberra. Research School of Physical Sciences). [1969]. 14p. Dep. CFSTI (U. S. Sales Only).

The beam-foil light source was used for a study of the Stark effect in He^+ (λ4686 Å) and H_β. For the former, the p and s components were detected for transverse and longitudinal fields. The transverse-field data suggest that levels of high j are underpopulated relative to their equilibrium numbers. The longitudinal-field data are anomalous. For H_β, splitting was observed but the arrangement precluded the detection of polarization. The data also imply underpopulation of levels of high j. (auth)

48716 K_α/K_β X-RAY INTENSITY RATIOS FOR ELEMENTS FROM Z = 29 TO Z = 92. Slivinsky, V. W.; Ebert, P. J. (Univ. of California, Livermore). Phys. Lett., 29A: 463-4(June 30, 1969).

The K_α/K_β x-ray intensity ratios were measured with a high-resolution Ge(Li) spectrometer. The results for the lower-Z elements were as much as 20% lower than previously reported measurements and recent radiative decay rate calculations. (auth)

48717 FRACTIONAL PARENTAGE COEFFICIENTS FOR EQUIVALENT p SHELL AND EQUIVALENT d SHELL ELECTRONS. Allison, D. C. S. (Queen's Univ., Belfast). Comput. Phys. Commun., 1: 15-20(July 1969).

Computer programs intended to identify and evaluate any allowed coefficient of fractional parentage associated with a particular state of the p^n or d^n configurations are described. Programs CFPP for p-shell electrons and CFPD for d-shell electrons are similar. Both are written in FORTRAN for ICL 1907. Typical running time is ≫1 sec for one coefficient. Output from test runs for each program is included. (A.G.W.)

48718 INNER ELECTRON BINDING ENERGY IN ATOMS AND IONS. Ha, Tae-kyu; O'Konski, Chester T. (Univ. of California, Berkeley). Chem. Phys. Lett., 3: 603-5(Aug. 1969).

The 1s-electron binding energies of first- and second-row atoms were obtained from Clementi's analytical Hartree-Fock wave functions with the use of Koopmans' theorem. These were compared with the differences of the expectation values of r^{-1} between various low-lying states of the charged and neutral atoms and the ground state of the neutral atom. Good agreement was found. Extension of this analysis to molecules and crystals should make possible a better interpretation of the chemical shift observed in photoelectron spectroscopy. (auth)

48719 ELECTRON-PHOTON COINCIDENCE METHOD FOR MEASURING ATOMIC AND MOLECULAR LIFETIMES. Imhof, R. E.; Read, F. H. (Manchester Lab., Eng.). Chem. Phys. Lett., 3: 652-4(Aug. 1969).

A new method is described for determining neutral atomic and molecular lifetimes by measuring delayed coincidences between inelastically scattered electrons and the subsequent decay photons. The lifetime of the 4^1S state of helium, as measured by this method, is 73 ± 2 nsec. (auth)

48720 ABSORPTION BY GASEOUS AND SOLID HD AND SOLID PARA-H_2 IN THE FAR INFRARED. Trefler, M.; Cappel, A. M.; Gush, H. P. (Univ. of Toronto). Can. J. Phys., 47: 2115-22(Oct. 1, 1969).

The absorption spectrum of HD at 300°K, 77.3°K, and 4.2°K (solid) has been measured in the frequency range of 40 to 450 cm^{-1}. The spectrum is the sum of a collision-induced part associated with $\Delta J = 2$ rotational-translational transitions, and an allowed electric-dipole part associated with $\Delta J = 1$ rotational transitions. The intensity of the induced part of the spectrum is compared with theoretical predictions; a significant discrepancy between the measured and calculated intensity of the S(0) line in the solid is noted. The intensity of the corresponding feature in solid parahydrogen has also been measured and a similar discrepancy exists. (auth) (Canada)

48721 MAGNETIC RESONANCE OF HYDROGEN MOLECULAR LEVELS EXCITED BY ELECTRON IMPACT. Marechal, M. A.;

Jourdan, A. (Univ., Grenoble, France). Phys. Lett., 30A: 31 (Sept. 8, 1969).

Magnetic resonance has been detected on four hydrogen molecular levels of the Fulcher band [$^3\Pi_u(1s,3p) - {}^3\Sigma_g(1s,2s)$]. Rough g values have been obtained. (auth)

48722 ANALYSIS OF ELECTRON CORRELATION IN TWO-ELECTRON SYSTEMS. I. H^-, He, AND Li^+. Banyard, K. E.; Baker, C. C. (Univ. of Leicester, Eng.). J. Chem. Phys., 51: 2680-9(Sept. 15, 1969).

Because they form the beginning of an isoelectronic series possessing electrons with antiparallel spins, H^-, He, and Li^+ lend themselves well to a study of electron correlation. The study is of three wave functions. Two introduce correlation: one by configuration interaction, the other by including Hylleraas-type correlation factors. For comparison, the third function is based on the Hartree–Fock approach. The correlation within the wave functions is demonstrated by presenting two-particle density difference maps, $\Delta D(r_1; r_2)$, relative to the uncorrelated approach, and graphs of the radial density D(r). Among the quantities calculated from the different treatments are $\langle \cos \gamma_{12} \rangle$, where γ_{12} is the angle subtended by the electrons at the nucleus, $\langle r_1 \cdot r_2 \rangle$, the coherent x-ray scattering contribution $f_{00}(X)$, and $\langle r^n \rangle$, where $-2 \leq n \leq 4$. Results are compared throughout with those from a more accurate wave function. In addition, it was possible to study the effects of radial and angular correlation separately by producing the natural expansion for one of the correlated functions. The main conclusion is that as Z increases, angular correlation replaces radial correlation in being more important. Further, s-type correlation terms in the wave function cause the density to spread, whereas angular terms generally contract it. All such correlation effects tend to decrease with increasing Z. (auth)

48723 PHOTOELECTRON SPECTROSCOPY OF AUTOIONIZATION PEAKS. Berkowitz, J.; Chupka, W. A. (Argonne National Lab., Ill.). J. Chem. Phys., 51: 2341-54(Sept. 15, 1969).

A vacuum ultraviolet monochromator has been combined with a retarding-field electron-energy analyzer to study the distribution of photoelectrons from autoionizing states of hydrogen and nitrogen. In most cases involving hydrogen, the photoelectrons produced are monoenergetic and correspond to autoionizing transitions in which Δv is a minimum, i.e., the ejected electrons have the minimum kinetic energy. There is one possible exception to this generalization. Different mechanisms appear to be operative in the nitrogen autoionizations. In general, several bundles of electrons, corresponding to the formation of several ionic states, are observed. Whereas vibrational relaxation of the core appears to explain the results with hydrogen, an alternative mechanism involving configuration interaction has been examined in an attempt to rationalize the nitrogen results. This proposed mechanism implies that relative transition probabilities in the autoionization process are dominated by Franck–Condon factors connecting the quasi-discrete state and the ionic state. The ratio of Franck–Condon factors is very sensitive to the choice of internuclear distance for the quasi-discrete state. In many cases, it is possible to find a plausible internuclear distance for which the ratio of Franck–Condon factors agrees with experiment. If the Franck–Condon factors are indeed the major determinant of relative transition probabilities, photoelectron spectroscopy offers a method for determining the internuclear distances of the quasi-discrete states. One autoionizing transition in nitrogen, as yet unassigned, does not seem to fit this mechanism. (auth)

48724 SEMIEMPIRICAL ENERGY SURFACE FOR H_3. Salomon, Mark (Electronics Research Center, Cambridge, Mass.). J. Chem. Phys., 51: 2406-10(Sept. 15, 1969).

A semiempirical potential-energy surface was generated from the London equation by evaluating the Coulomb and exchange integrals using a method that takes into account the effective orbital overlap as a function of internuclear distance. A single adjustable parameter is used to fit the calculated activation energy to the observed value. The surface is symmetrical and very flat over the saddle-point region, which leads to much lower values for the probability of H-atom tunneling through the barrier. (auth)

Positronium, Muonium, and Mesic Atoms and Molecules

Refer also to abstract 49163.

48725 POSITRON ANNIHILATION AND DEFECTS IN METALS. Connors, D. C.; West, R. N. (Univ. of East Anglia, Eng.). Phys. Lett., 30A: 24-5(Sept. 8, 1969).

Measurements of the temperature dependence of positron lifetimes in some metals show a marked increase in lifetimes below the melting point. A simple theoretical treatment assuming "trapping" of positrons by defects reproduces the essential features of these measurements. (auth)

48726 REGION OF POSSIBLE EXISTENCE OF 2S POSITRONIUM IN A MEDIUM. Urbanovich, S. I. (Inst. of Physics, Minsk). JETP Lett. (USSR) (Engl. Transl.), 9: 425-7(June 20, 1969).

Translated from Zh. Eksp. Teor. Fiz., Pisma Redaktsiyu, 9: 683-5(June 20, 1969).

Calculations concerning the possible existence of 2^3S_1 and 2^1S_0 states of positronium and conditions for their stability are presented. Results indicate that 2^3S_1 positronium can exist in principle when $p < 10^{-3}$ torr and the internal electric field of the medium is <0.1 V/cm. (A.G.W.)

48727 DETERMINATION OF THE MUONIUM HYPERFINE SPLITTING AT LOW PRESSURE FROM A FIELD-INDEPENDENT ZEEMAN TRANSITION. Ehrlich, R. D.; Hofer, H.; Magnon, A.; Stowell, D.; Swanson, R. A.; Telegdi, V. L. (Univ. of Chicago). Phys. Rev. Lett., 23: 513-17(Sept. 8, 1969).

The ground-state hyperfine interval $\Delta\nu$ of muonium was redetermined in argon by measuring the (1,1) ⇌ (1,0) Zeeman frequency ν_1 at that external-field value where $\partial\nu_1/\partial B = 0$. The measurements were performed with good statistics at much lower argon pressures than heretofore, greatly reducing uncertainties in extrapolating $\Delta\nu(p)$ to zero pressure. The result, $\Delta\nu(0) = 4463.317 \pm 0.21$ MHz, disagrees with the value found by Thompson et al. in Ar, but is consistent with their result in Kr. (auth)

48728 SUBEXCITATION POSITRONS. Brandt, Werner (New York Univ. Centre d'Etudes Nucleaires, Grenoble, France); Feibus, Howard. Phys. Rev., 184: 277-81(Aug. 10, 1969).

Lifetime spectra of positrons in positronium (Ps)-forming substances can be affected significantly by the addition of small concentrations of impurities with ionization potentials smaller than those of the pure substances. Such impurities permit Ps formation by subexcitation positrons, i.e., by positrons with kinetic energies less than the threshold energy for the formation of Ps in the pure substance. The impurity-induced Ps yield can increase further under the influence of an electric field at field strengths so moderate that the Ps yield in the pure substance remains unaffected. The quantitative aspects of the impurity-induced electric field effect are indicative of the cross sections for elastic scattering and for energy loss of subexcitation positrons in the substance. Therefore, subexcitation positrons permit the experimental study of electronic subexcitation cross sections in a large class of substances. (auth)

Collision Phenomena

Refer also to abstracts 47737, 48818, and 49224.

48729 (ANL-Trans-774) CALCULATING THE SLOWING-DOWN PROCESS OF NONRELATIVISTIC ELECTRONS IN HELIUM. Alkhazov, G. D. (Akademiya Nauk SSSR, Leningrad, Fiziko-Tekhnicheskii Institut). Translated for Argonne National Lab., Ill., from report FTI-108. 42p. Dep. CFSTI.

The ionization cascade of electrons with an initial energy of $E \leq 2.5$ keV in helium was calculated in detail. The following quantities were determined: the mean energy released for the production of one ion–electron pair (W = 46.2 eV); the Fano coefficient (F = 0.213); the average number of various excited states of atoms produced during slowing-down as well as the photon spectrum emitted during the transition of atoms from excited states into metastable states; the degradation spectrum of electrons (including the spectrum of subthreshold electrons); W and F as functions of the probability of secondary ionization as a result of de-excitation. (auth)

48730 (N-69-32038) BOUND BOUND TRANSITIONS IN HYDROGEN LIKE ATOMS INDUCED BY FAST CHARGED PARTICLES. Omidvar, Kazem (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). July 1969. 27p. (NASA-TM-X-63612; X-641-69-305). CFSTI.

Considering the transition from the nl level in a hydrogen-like atom to the n'l' level induced by fast charged particles of mass M, charge z, and energy E, when $(M/\mu)(\Delta E/E) \ll 1$, with μ the electronic charge and ΔE the excitation energy, the excitation cross section can be written as: $Q_{BB}(nl,n'l') = (Mz/\mu_T)^2 E^{-1} [A(nl, n'l') \ln E + B(nl, n'l')]$ where Z is the nuclear charge, and A(nl, nl') and B(nl, n'l') are constants. In this paper an analytic expression for A(nl, n'l') and B(nl, n'l') is found. These coefficients, after being averaged with respect to l and summed with respect to l' are given numerically for n = 1 to 9 and a range of n' from n + 1 to 20. Also the Born cross sections $Q_B(n, n')$ for many transitions are given. Because of the shortage of space, cross sections not for all but for some transitions between dif-

ferent azimuthal quantum numbers are given here. Marked disagreement with some of the data of the previous authors is found. (auth) (STAR)

48731 (NYO-1932(2)-154) PHASE INTERFERENCE EFFECTS IN INELASTIC He^++He COLLISIONS. Rosenthal, H.; Foley, H. M. (Columbia Univ., New York). [1968]. 12p. Dep. CFSTI.

In the collision $He^+ + He \rightarrow He^+ + He^*$, excitation at low incident ion energies (≤1 keV) proceeds via a pseudocrossing of the elastic $^2\Sigma_g$ diabatic potential with excited-state $^2\Sigma_g$ potentials. In addition, pseudocrossings of inelastic potentials at large internuclear separations coherently mix the amplitudes of the excited-state channels. This many-state mechanism provides qualitative understanding of diverse experimental observations. (auth)

48732 (ORNL-AMPIC-4) BIBLIOGRAPHY OF ATOMIC AND MOLECULAR PROCESSES FOR JANUARY-JUNE 1965. (Oak Ridge National Lab., Tenn.). June 1967. 156p. Dep. CFSTI.

This annotated bibliography contains references of interest to atomic and molecular processes research. Bibliographical sources consisted of seventy-eight scientific journals and five abstract journals. The references are classified into fourteen major categories with appropriate subcategories. Each entry in the respective category is entered alphabetically and includes the reactants or the atomic and molecular system of interest. (auth)

48733 (SRIA-115-P-78-1) COLLISION SPECTROSCOPY OF 2^3S EXCITATION IN He BY He^+ IMPACT. Coffey, Dewitt Jr.; Lorents, D. C.; Smith, F. T. (Stanford Research Inst., Menlo Park, Calif.). July 28, 1969. 5p. (CONF-690702-6). Dep. CFSTI.

From 6th International Conference on the Physics of Electronic and Atomic Collisions, Cambridge, Mass.

Differential cross sections for excitation of the 2^3S state in He by He^+ were measured at center-of-mass energies from 300 eV down to 37.5 eV. The deflected current, the angle of scattering, and the energy loss of the scattered ions were measured. Results are presented in the form of a plot of the reduced cross section $\rho = \theta \sin\theta\, \sigma(\theta,E)$ as a function of the reduced angle $\tau = E\theta$, where the energy E, the angle θ, and the cross section σ are taken in the center-of-mass frame. Prominent features of the process are discussed briefly. (A.G.W.)

48734 THE EXCITATION FUNCTION OF THE Ca 4^1p^0 TERM FOR EXCITATION BY ELECTRONS. Heyner, W.; Karstensen, F. (Univ., Kiel). Z. Phys., 228: 53-8(1969). (In German).

The electron-impact excitation of the Ca $4\ ^1P^0$ term was measured as a function of the energy of the exciting electrons. Cascading effects from higher excited states are taken into account. For low energies the cross section for direct population of the $4\ ^1P^0$ term from the ground state can be described by the function $2.63 \times 10^{-16}\ [(E - E_0)/E^2]$ ln 0.43 E cm^2. (auth)

48735 MULTICHANNEL TREATMENT OF THE (e,H) COLLISION PROBLEM USING THE QUASIPARTICLE METHOD. Weiss, U.; Weidlich, W. (Univ., Stuttgart). Z. Phys., 228: 1-15(1969).

The (e, H) collision problem is treated using the multichannel quasi-particle method recently introduced by Grassberger and Sandhas. Single-variable integral equations are derived for the singlet and triplet transition amplitudes valid for scattering energies up to E ≈ 8 eV and the scattering lengths are calculated. The results are in good agreement with previous results found by variational methods. (auth)

48736 ENERGY LOSSES OF MONOCHROMATIZED 30-keV LITHIUM IONS IN ARGON AND ETHYLENE. Nicolai, Rainer (Technical Univ., Berlin). Z. Phys., 228: 16-24(1969). (In German).

The energy-loss spectra of 30-keV $^7Li^+$ ions after interaction with argon and ethylene were studied. Wien filters were used as monochromator and energy analyzer; an energy resolution of 0.2 eV was achieved. The ion energy-loss spectra obtained differ from those taken with electrons at the same primary energy mainly in two points: In the ion spectra energy losses are found with strong intensities corresponding to optically forbidden transitions not excited by fast electrons. Furthermore in the energy range beyond the first ionization limit energy losses appear, which are due to charge transfer into excited states of the lithium atom and re-ionization. (auth)

48737 REACTIONS OF EXCITED ATOMS AND MOLECULES WITH ATOMS AND MOLECULES. II. ENERGY ANALYSIS OF PENNING ELECTRONS. Hotop, H.; Niehaus, A. (Univ., Freiburg i. B.). Z. Phys., 228: 68-88(1969).

Energy distributions of electrons ejected in thermal collisions of He(2 ^1S) and He(2 ^3S) metastables with Ar, Kr, Xe, and Hg are measured using a retarding electric field in combination with an electrostatic lens. The distributions are broadened and shifted with respect to the energy difference ($E^* - IP$) between excitation energy of the metastable (E^*) and the ionization energy of the target atom (IP), because of the mutual interaction. The shapes and shifts of the distributions are very different for He(2 ^1S) and He(2 ^3S) metastables and show a marked change with the relative energy of the collision. The shifts $\Delta E = E_{el} - (E^* - IP)$ vary from +45 mV for Ar to −50 mV for Hg as the size of the target atom is increased. The ratio of associative to Penning ionization, approximately predictable from the shifts, is in agreement with the mass spectrometrically determined ratio. The molecular ions are formed in highly vibrationally and rotationally excited states with binding energies varying from zero to thermal energies. Details of the distributions are discussed in terms of potential curves. It is shown that the known experimental facts on Penning ionization are best interpreted if it is assumed that the process takes place by electron exchange between metastable and target atom. Based on this assumption an approximate expression for the Penning cross section is derived. (auth)

48738 RESONANCE TRANSFER OF EXCITATION DURING COLLISION OF HEAVY ATOMS. Chibisov, M. I. Dokl. Akad. Nauk SSSR, 186: 1063-6(July 11, 1969). (In Russian).

Excitation transfer is important in the physics of slightly ionized gases. An important process of resonance excitation transfer takes place on collision of two like atoms, one of which is in the ground state, while the other is excited in such a fashion that an optical dipole transition to the ground state is allowed. This process is doubly resonant. First, the excitation transfer takes place without a change in electron energy. Second, the interaction in this case is a maximum, a dipole−dipole one. The cross sections for the exchange of S and P states are calculated for collisions of like single-electron atoms. At small relative velocities the internuclear distances are large compared to the atomic sizes, so that the wave functions of the system of electrons are derivatives of the atomic functions with given principal quantum numbers. The hamiltonian of the system consists of the sum of the atomic hamiltonians, in which the spin−orbital and dipole−dipole interactions are taken into account. The probabilities of excitation transfer are presented in graphical form. The dipole moments of the resonance transfers in Cs, Rb, K, Na, and Li were found to be 14.1, 13.0, 12.5, 9.5, and 5.65 atomic units, respectively. The fine splitting of the first excited state of Cs, Rb, K, Na, and Li was found to be 2.52×10^{-3}, 1.08×10^{-3}, 2.63×10^{-4}, 7.82×10^{-5}, and 1.55×10^{-6} atomic units, respectively. (TTT)

48739 SCATTERING OF ELECTRONS BY LIGHT ATOMS ABOVE THRESHOLD ENERGY. Birman, A.; Rosendorff, S. (Israel Inst. of Tech., Haifa). Nuovo Cim., 63B: 89-104(Sept. 11, 1969).

Two different methods are used to calculate the cross section for the elastic scattering by hydrogen and helium atoms of electrons whose energy is above threshold. One method is the second-order Born approximation, where the evaluation of the infinite sum over the intermediate states is made by introducing the mean excitation energy of the atom in the intermediate states as a free parameter. Numerical calculations have been performed for different values of this parameter and compared with experimental data. The other method is the impact-parameter approximation for bound states. This approximation seems to yield reliable results at small scattering angles, except in the case of the very forward direction where the approximation diverges logarithmically. This divergence is traced back to the fact that all the energies of the intermediate states were put equal to the energy of the initial state. (auth)

48740 PROGRAM TO CALCULATE RADIATIVE RECOMBINATION COEFFICIENTS OF HYDROGENIC IONS. Flower, D. R.; Seaton, M. J. (University Coll., London). Comput. Phys. Commun., 1: 31-4(July 1969).

A computer program for calculating the coefficients $\alpha_n(Z,T)$ for radiative recombination to energy levels of principal quantum number n of hydrogenic ions is described, Z being the nuclear charge and T the electron temperature. The program also calculates sums of recombination coefficients from $n = n^{2?}$ to $n = \infty$. The recombination coefficients are expressed as integrals over the photoionization cross sections, which are evaluated using the first three terms in the asymptotic expansion of the Kramers−Gaunt g factor. The accuracy of the final results is determined by the approximation used for the g factor. The program is written in FORTRAN IV for IBM 360/65. (A.G.W.)

48741 COLLISIONAL EXCITATION TRANSFER IN THE GAS PHASE. Watanabe, Tsutomu (Univ. of Notre Dame, Ind.). Advan. Chem. Ser., No. 82, 176-96(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.2).

The cross sections of processes $A^* + A \rightarrow A + A^*$, $A^* + B \rightarrow A + B^*$, and $A^* + B \rightarrow A + B^+ + e$ were studied theoretically. The cross sections are sometimes large (of the order of $10^2 \sim 10^3$ sq Å at thermal energies) compared with those of other processes. Some typical examples of the calculated cross sections are listed, mainly for "optically allowed" excitations. Calculations for other cases are mentioned briefly. Relations with gas-phase experiments (e.g., the pressure effect of excitation transfer, the temperature effect of spectral line width, etc.) are also discussed. (auth)

48742 LOW-ENERGY ION–NEUTRAL REACTIONS. I. $^{22}Ne^+ + {}^{20}Ne$, AND $Ar^+ + N_2$. Kaneko, Yozaburo; Kobayashi, Nobuo; Kanomata, Ichiro (Tokyo Metropolitan Univ.). J. Phys. Soc. Jap., 27: 992-8(Oct. 1969).

A series of experiments was performed using a drift-tube technique in which both the primary and secondary ions are mass identified. Design of the apparatus is described briefly. Drift velocities of ions in the drift tube are measured with a gate pulse technique. Cross sections of reactions $^{22}Ne^+ + {}^{20}Ne \rightarrow {}^{22}Ne + {}^{20}Ne^+$ and $Ar^+ + N_2 \rightarrow Ar + N_2^+$ are determined as functions of mean energies of the ions in the range from 0.04 to 4 eV. The cross section of the former reaction decreases from $5.2 \pm 0.2 \times 10^{-15}$ cm^2 at 0.045 eV to $3.7 \pm 0.2 \times 10^{-15}$ cm^2 at 2.5 eV. Comparisons of measured cross section with the theory of Rapp–Francis and the previous experiments show that the technique and apparatus used are quite reliable. The cross section of the latter reaction increases from $3.0 \pm 0.3 \times 10^{-16}$ cm^2 at 0.43 eV to $2.2 \pm 0.2 \times 10^{-15}$ cm^2 at 4.4 eV, and it does not agree with the previous experiments using beam techniques at higher energy. (auth)

48743 THRESHOLD EXCITATION AND IONIZATION OF XENON BY ELECTRON IMPACT. Brion, C. E.; Eaton, C. R.; Olsen, L. A. R.; Thomas, G. E. (Univ. of British Columbia, Vancouver). Chem. Phys. Lett., 3: 600-2(Aug. 1969).

The threshold electron-impact spectrum of xenon has been obtained using a velocity-selected electron beam. Fine structure both above and below the first ionization potential is observed. Sulfur hexafluoride scavenging is used as the detection method. (auth)

48744 LYMAN-α RADIATION FROM ELECTRON COLLISIONS WITH SIMPLE HYDROGEN-CONTAINING MOLECULES. McGowan, J. William; Williams, J. F.; Vroom, D. A. (Gulf General Atomic Inc., San Diego, Calif.). Chem. Phys. Lett., 3: 614-16(Aug. 1969).

The dissociative excitation cross section giving H(2p) is large for H_2, H_2O, D_2O, NH_3, CH_4, and C_2H_6, and in all cases but H_2 it is the dominant excitation mechanism in the vacuum ultraviolet. (auth)

48745 MODERATION PROCESSES OF HOT ATOMS IN A GASEOUS MEDIUM. Baer, Michael (Soreq Nuclear Research Centre, Yavne, Israel). Chem. Phys. Lett., 3: 629-31(Aug. 1969).

One of the results derived in the different experiments performed with hot atoms moving in gaseous medium is the ratio α_1/α_2 for two moderators. It is shown that this ratio equals the ratio $(1-\beta_1)/(1-\beta_2)$ where $\beta_1 = (m - M_1)^2/(m + M_1)^2$ 1 = 1.2. The masses m and M_1 are those of the hot and inert atom, respectively. (auth)

48746 OSCILLATORY STRUCTURE IN MEASURED TOTAL $Li^+ + Li$ CHARGE TRANSFER AND COMPARISON WITH THEORY. Perel, Julius (Electro-Optical Systems, Pasadena, Calif.); Daley, Howard L.; Peek, James M., Green, Thomas A. Phys. Rev. Lett., 23: 677-80(Sept. 29, 1969).

Measured $Li^+ + Li$ total charge-transfer cross sections are reported and compared with the computed results of Peek, Green, Perel, and Michels based on an ab initio two-state calculation. Both experiment and theory show oscillatory structure in the cross sections with very good agreement in cross-section magnitude and oscillatory structure. There exist, however, small but important differences in the oscillation characteristics. (auth)

48747 EXCITATION OF HYDROGEN 3s, p, d STATES BY ELECTRON IMPACT. Gumble, Roger S. (Univ. of Toledo). J. Phys. Soc. Jap., 27: 973-5(Oct. 1969).

The Ochkur approximation method was used to calculate the excitation cross section for the $1s \rightarrow 3s$, p, d transitions of H in electron–hydrogen collisions. The results of this calculation are compared with those of other approximation methods and with experimental results. (auth)

48748 A TWO-CENTER APPROACH IN LOW-ENERGY ELECTRON–H_2 SCATTERING. Hara, Shunsuke (Tokyo Univ.). J. Phys. Soc. Jap., 27: 1009-19(Oct. 1969).

The differential and total cross sections for the elastic scattering of slow electrons by the hydrogen molecule are calculated by solving the scattering equation in two-center prolate spheroidal coordinates. The two nuclei are fixed in the calculation and the average over the molecular orientation is taken afterward. The exchange effect is taken into account by properly antisymmetrizing the wave function with respect to three electrons in the system and the polarization effect is approximately represented by the adiabatic dipole polarization potential. The results of the calculation agree well with experimental data when the exchange and the polarization effects are taken into account. The change of the magnitude in the forward scattering as a function of the incident energy is explained by the polarization effect. (auth)

48749 IONIZATION AND EXCITATION OF NITROGEN BY PROTONS AND HYDROGEN ATOMS IN THE ENERGY RANGE 1 TO 25 keV. McNeal, R. J.; Clark, David C. (Aerospace Corp., El Segundo, Calif.). J. Geophys. Res., 74: 5065-72(Oct. 1, 1969).

Recent measurements of the energy spectra of protons and hydrogen atoms in breakup auroras have found significant fluxes at energies near 1 keV. Cross sections for ionization and light emission for collisions of protons and hydrogen atoms with atmospheric gases are useful in analysis of these auroral events. Atomic beam measurements are reported of ionization and charge-capture cross sections for proton bombardment of N_2, of ionization and stripping cross sections for hydrogen atom bombardment of N_2, and of the relative cross sections for emission of N_2^+ 391.4-nm radiation in collisions of protons and hydrogen atoms with N_2 in the energy range 1 to 25 keV. (auth)

48750 THRESHOLD ELECTRON-IMPACT EXCITATION AND NEGATIVE-ION FORMATION IN XeF_6 AND XeF_4. Begun, G. M.; Compton, R. N. (Oak Ridge National Lab., Tenn.). J. Chem. Phys., 51: 2367-70(Sept. 15, 1969).

Electronic excitation and dissociative electron attachment in XeF_6 and XeF_4 were investigated by studying the products of low-energy electron–molecule collisions in the gas phase. The relative abundances of the major negative ions produced were recorded as a function of the electron-beam energy. Both molecules attached electrons at ~0 and ~5 eV and dissociated into a number of negative-ion products. The similar energy dependence of the various ion currents suggested that the fragment ions were competing for the electron attached to XeF_6 or XeF_4. The threshold electron-impact excitation spectra were determined by means of the "SF_6-electron-scavenger" technique. No evidence for low-lying electronic states was found. (auth)

48751 UPPER BOUNDS ON MANY-CHANNEL SCATTERING PHASE SHIFTS BY AN ADIABATIC-TYPE APPROXIMATION. Gerber, R. B.; Karplus, M. (Harvard Univ., Cambridge, Mass.). J. Chem. Phys., 51: 2726-34(Sept. 15, 1969).

An approximate equation for the treatment of atom–atom collision problems is proposed, based on the assumption that in the closed channels nuclear kinetic energy is negligible compared with the electronic energy. It is shown that this approximation yields upper bounds on the exact scattering phase shifts when the collision energy lies below the lowest nonadiabatic resonance level. To test the quality of this approximation, three model problems, all of them involving two coupled channels one of which is closed, are introduced. Each of these models is solvable exactly, solvable in the ordinary adiabatic approximation (which provides lower bounds on the phase shifts) and solvable within the new approximation. The accuracy of the results obtained is discussed with special reference to its dependence upon the form and strength of the interactions involved. (auth)

Atomic Theory

Refer also to abstract 49451.

48752 RADIAL CORRELATION IN ATOMS. Kantseryavichyus, A.; Zhilionite, S. (Inst. of Physics and Mathematics, Vilnyus, USSR). Liet. Fiz. Rinkinys, Liet. TSR Mokslu Akad., Liet. TSR Aukst. Mokyklos, 8: 737-47(1968). (In Russian).

The improvement of the radial part of the wave function of the equivalent electron shell is considered. The wave function is formed from the nonorthogonal terms of the linear independent, radial orbitals. The energy matrix elements are given. The numerical results are given for $1s^2$, $2p^N$, and $3d^N$ shells. The radial correlation increased with N monotonously and rather rapidly ($\sim N^3$). The contribution of the correction terms increased with N and quantum number *l*. (auth)

48753 FRACTIONAL PARENTAGE COEFFICIENTS WITH TWO DETACHED ELECTRONS FOR SHELLS OF p AND d ELECTRONS. Vizbaraite, Ya. I.; Savukinas, A. Yu.; Jucys, A. P.

(Inst. of Physics and Mathematics, Vilnyus, USSR. Vilnyus State Univ., USSR). Liet. Fiz. Rinkinys, Liet. TSR Mokslu Akad., Liet. TSR Aukst. Mokyklos, 9: 5-37(1969). (In Russian).

The phase relation between the wave functions of the same shell of equivalent atomic electrons partially filled, and almost filled is considered. The general connection between the fractional parentage coefficients for the almost-filled shell and those for the partially filled shell is given. The fractional parentage coefficients with two detached electrons for the shells of p and d electrons are calculated and tabulated. (auth)

48754 CALCULATION OF TWO-ELECTRON MATRIX ELEMENTS FOR THE MAGNETIC INTERACTION OPERATORS IN ATOMS. Eriksonas, K. M.; Karaziya, R. I.; Chiplis, I. V. (Inst. of Physics and Mathematics, Vilnyus, USSR). Liet. Fiz. Rinkinys, Liet. TSR Mokslu Akad., Liet. TSR Aukst. Mokyklos, 9: 105-13(1969). (In Russian).

The methods of calculation of two-electron matrix elements of spin–spin, spin–orbit, and orbit–orbit interaction operators with the help of irreducible tensor operators is discussed. The expressions for the matrix elements in terms of the radial integrals in the most general cases are given. (auth)

48755 GROUP THEORY AND MIXED ATOMIC CONFIGURATIONS. Morrison, J. C. (Johns Hopkins Univ., Baltimore). J. Math. Phys. (N.Y.), 10: 1431-7(Aug. 1969).

A group-theoretical scheme is introduced to classify the states of an atomic system having two open shells. States labeled according to this scheme may be written $|(l_A + l_B)\alpha Q_A(S_A L_A)J_A \times \beta Q_B(S_B L_B)J_B, QM_Q JM_J\rangle$, where the quasi spins Q_A and Q_B are coupled together to form a total quasi spin Q. Although these states are, in general, mixtures of different configurations $l_A^{\alpha} l_B^{\beta}$, it is found that they serve as a convenient basis for the calculation of matrix elements in $(l_A + l_B)^N$. The matrix elements of operators between the states of two configurations are obtained from these matrix elements by means of a unitary transformation. As an example matrix elements of the Coulomb interaction within $(f + p)^N$ are calculated. (auth)

Cosmic Radiation

Refer also to abstracts 47756, 47841, and 48915.

48756 (AECL-3385) COSMIC RAY NM-64 NEUTRON MONITOR DATA, CHACALTAYA, BOLIVIA. II. JANUARY 1968–DECEMBER 1968. Zubieta, M.; Mejia, G. R.; Steljes, J. F. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). June 1969. 55p. (In English and Spanish). Dep. CFSTI (U. S. Sales Only). CAN $1.50.

Uncorrected and barometer corrected results from the cosmic-ray station at Chacaltaya, Bolivia, are given in tabular form from January 1968 to December 1968. Normalized graphs of the neutron monitor and of the barometric pressure are also given. (auth)

48757 (AECL-3413) COSMIC RAY MT-64 MUON MONITOR DATA. I. FROM START-UP OF THE MONITORS UNTIL THE END OF ROTATION 1812 (JANUARY 19, 1966); AND MONTHLY GRAPHS. Steljes, J. F. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Deep River Lab.). July 1969. 87p. Dep. CFSTI (U. S. Sales Only). CAN $2.00.

Hourly rates corrected for atmospheric temperature and pressure from four cosmic-ray stations in Canada which have muon monitors maintained by AECL are given in tabular form by solar rotation for the period from the startup of the monitors until the end of Rotation 1812 (January 19, 1966). The Dorman–Maeda temperature correction factors for each station calculated at 12 hour intervals from the radiosonde data of the Canadian Meteorological Branch are also listed. Barometric pressures are available from neutron monitor data reports already published. Graphs of the relative hourly rates at each station are given. (auth)

48758 (N-69-31835) MODULATION AND HELIOCENTRIC GRADIENT OF LOW-ENERGY COSMIC RAYS NEAR SOLAR MINIMUM, 1965. Kane, S. R.; Winckler, J. R. (Minnesota Univ., Minneapolis. School of Physics and Astronomy). Mar. 1969. Contract NAS5-2071. 28p. (NASA-CR-103435; CR-131). CFSTI.

Cosmic-ray total ionization measurements made in space near the earth with the OGO-1 and OGO-4 ion chambers during the period September 1964–December 1967 are presented. To determine the characteristics of the solar modulation and the heliocentric gradient of the galactic cosmic rays the OGO measurements are compared with measurements made with the Mariner 4 ion chambers, Mariner 4 cosmic-ray telescope, and Deep River neutron monitor. The findings are: (1) The recovery phase of the 11-year variation is characterized by the simultaneous recovery of all particles with energy 10 MeV per nucleon. (2) The long-term modulation of the low-energy particles was less during the early decreasing phase giving rise to the hysteresis effect. The observed effect disappeared completely by April 22–28, 1967. (3) The hysteresis effect is probably characteristic of the modulation mechanism. (4) The observations in 1964–1965 are consistent with a heliocentric gradient of ≅0% per au in the range 1.0 to 1.28 au and probably also in the range 1.0 to 1.56 au. (auth) (STAR)

48759 OBSERVATIONS OF COSMIC-RAY ELECTRONS BETWEEN 2.7 AND 21.5 MeV. Simnett, G. M.; McDonald, F. B. (Goddard Space Flight Center, Greenbelt, Md.). Astrophys. J., 157: 1435-47(Sept. 1969).

Results are presented from the IMP-IV satellite on the intensity of electrons with energies of 2.7 to 21.5 MeV in interplanetary space during the period July 3 through August 27, 1967. The measured electron intensity is believed to be uncontaminated by solar electrons. The analysis procedure for background subtraction and the subsequent derivation of the electron spectrum are described in detail. The results of electron-accelerator calibrations are used extensively. The origin of the electrons is discussed, and the results are compared with the predicted intensity of knock-on electrons from proton–electron collisions in interstellar space. The measured electron spectrum is shown to be compatible with a sole origin in the galactic knock-on component if solar modulation of low-energy electrons is insignificant. The energy spectrum of the electrons that was obtained is well represented by a power law of the form $dJ/dE = 132\ E^{-1.75}$ electrons $(m^2\ sterad\ MeV)^{-1}$ between 2.7 and 21.5 MeV. (auth)

48760 GROWTH RATE OF THE RELATIVISTIC FIRE-HOSE INSTABILITY. Noerdlinger, Peter D.; Yui, Alexander Ko-min (Univ. of Iowa, Iowa City). Astrophys. J., 157: 1147-56(Sept. 1969).

The growth rate of the fire-hose instability in a relativistic plasma with anisotropic pressure is given as a function of wavenumber, degree of anisotropy, magnetic field, density of the cold background, and mean relativistic energy factor $\langle\gamma\rangle = \langle E/Mc^2\rangle$. If the wavenumber is adjusted to give the fastest growth rate in a given unstable plasma, the growth rate can be approximated to within about 20% by the expression, $\omega_3 = [\omega_L/\langle\gamma\rangle][1.3(1 - H)/\sqrt{\Lambda + 8}]$; $(0 < H < 1)$, where $\Lambda = 1 + c^2/v_A^2$ and $H = B_0^2/4\pi(P_{||} - P_{\perp})$. The dependence on $\langle\gamma\rangle$ contrasts strongly with that reported by Tsytovich and suggests that the instability is much more important in ultrarelativistic plasmas. The growth rates indicate that the instability should be important in liberating cosmic rays at the outer boundary of the galactic halo. If Smith's recent measurement of the magnetic field in the galactic disk, $B_0 < 2 \times 10^{-7}$ gauss, is typical in the disk, the instability would also be important in isotropizing cosmic rays there. For plasmas far from marginal stability, the growth rates agree well with those given recently by Wentzel in the limit $v_A \ll c$. Near the stability boundary, the growth rates run up to about a factor 5 higher. (auth)

48761 COSMIC-RAY LATITUDE SURVEY IN NORTH AMERICA IN SUMMER 1965. I. Carmichael, H. (Atomic Energy of Canada Ltd., Chalk River, Ont.); Bercovitch, M.; Steljes, J. G.; Magidin, M. Can. J. Phys., 47: 2037-50(Oct. 1, 1969).

A 3-NM-64 neutron monitor and a 2-MT-64 muon monitor were operated overland at 44 sites near sea level and on mountains in Canada, the USA, and Mexico in April, May, and June, 1965, when the intensity of cosmic radiation attained its 11-year maximum. The equipment is briefly described and the original results of the measurements are listed. Some necessary corrections for instrumental effects are discussed. The corrections made to eliminate the secular variations of the cosmic radiation and the dependence upon temperature structure of the atmosphere are given in detail. This paper is the first of a set of five dealing with latitude surveys made in 1965 and 1966. Reduction of the observations to a common pressure level is carried out in the final paper of the set. (auth) (Canada)

48762 COSMIC-RAY LATITUDE SURVEY IN CANADA IN DECEMBER 1965. II. Carmichael, H.; Bercovitch, M. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Phys., 47: 2051-5(Oct. 1, 1969).

A small latitude survey was made in Canada in December, 1965, while the intensity of cosmic radiation was still within 1% of its IQSY maximum. Flat sites at airports were used in the hope of eliminating environmental effects noted in the 1965 summer survey and particular care was taken to verify the barometric data. The objective was to improve upon the summer measurements as regards the boundary of the high-latitude plateau of the neutron-monitor intensity and it is believed that an intrinsic accuracy within 0.1% was achieved, but it was found that the NM-64 neutron-monitor counting rate was decreased about 0.5% by the presence

of snow on the ground. The intensity near sea level appeared to be constant to the southern boundary of the survey at Windsor Airport (1.56 GV). The two most southerly sites, Windsor and Toronto (1.33 GV), were snow-free. (auth) (Canada)

48763 COSMIC-RAY LATITUDE SURVEY IN WESTERN USA AND HAWAII IN SUMMER, 1966. III. Carmichael, H. (Atomic Energy of Canada Ltd., Chalk River, Ont.); Shea, M. A.; Peterson, R. W. Can. J. Phys., 47: 2057-65(Oct. 1, 1969).

A 3-NM-64 neutron monitor and a 2-MT-64 muon monitor were operated at 29 sites near sea level and on mountains on the western seaboard of the USA and in Hawaii in May, June, and July, 1966, in continuation of the latitude survey begun in 1965 and reported in papers I and II of this set of five papers. The original results and also the corrections for temperature structure of the atmosphere and for secular variations of the cosmic radiation are given in detail. While the overland equipment was at its highest altitude on Mt. Hood (2.4 GV) and on the summits of Mt. Palomar (5.7 GV) and Mt. Haleakela (13.3 GV), an airborne neutron monitor was operated at seven different levels between 3,000 and 12,000 m. The pressure-measuring equipment and also the neutron monitor in the aircraft were calibrated in terms of the overland instruments while the aircraft was at the same altitude as the overland equipment on the summit of Mt. Haleakela. (auth) (Canada)

48764 GEOGRAPHICALLY SMOOTHED GEOMAGNETIC CUTOFFS. IV. Carmichael, H. (Atomic Energy of Canada, Ltd., Chalk River, Ont.); Shea, M. A.; Smart, D. F.; McCall, J. R. Can. J. Phys., 47: 2067-72(Oct. 1, 1969).

Detailed calculations of effective vertical-trajectory cutoff rigidities have failed to eliminate a discontinuity in the neutron-monitor latitude variation in the vicinity of Mexico City noted after the 1965 survey described in paper I of this set of five papers. Since a similar discontinuity appears when the vertical cutoffs are plotted against geographical latitude, the irregularity seems to be a function of the vertical rigidity cutoffs. Extensive calculations of cutoff's at intervals of one degree of latitude along meridians 260°E and 285°E have delineated the systematic nature of the irregularity. A set of cutoff values, which orders the observations satisfactorily for the analysis in the present papers, was obtained by smoothing a 5° latitude by 15° longitude grid of calculated values within a sector of the northern hemisphere bounded by meridians 195°E and 285°E. (auth) (Canada)

48765 ANALYSIS OF IQSY COSMIC-RAY SURVEY MEASUREMENTS. V. Carmichael, H. (Atomic Energy of Canada Ltd., Chalk River, Ont.); Bercovitch, M. Can. J. Phys., 47: 2073-93(Oct. 1, 1969).

In this, the last of a set of five papers reporting latitude surveys carried out in 1965 and 1966 at the time of and soon after the IQSY cosmic-ray maximum, the observations are reduced to a common atmospheric depth and at the same time the attenuation coefficients in the atmosphere for both the neutron monitor and the muon monitor are determined as functions of altitude and latitude. The latitude variation of the neutron monitor at sea level is compared with observations reported for the previous cosmic-ray maximum in 1954–55 and found to be similar. The altitude variation of the neutron-monitor attenuation coefficient is discussed in detail with reference to the maximum near 600 mm Hg currently attributed to neutrons produced in the monitor by stopping muons. It is shown that the stopping-muon effect is insufficient to account for the maximum. It is shown, using the Gross transformation, that a geometrical effect associated with the omnidirectional nature of the incident cosmic radiation may be the main factor producing the maximum. A specific absorption coefficient representing the differential effect in the neutron monitor of vertically incident primaries of given magnetic rigidity is deduced. Good agreement is obtained with the observed attenuation in the atmosphere of solar protons of mean energy 2 GV and also with the reported results of a Monte Carlo calculation of the attenuation of the nucleonic cascade in air. (auth) (Canada)

48766 COSMIC-RAY NEUTRON MONITOR FOR OGO-F. Lockwood, John A.; Chupp, Edward L.; Jenkins, Robert W. (Univ. of New Hampshire, Durham). IEEE (Inst. Elec. Electron. Eng.), Trans. Geosci. Electron., GE-7: 88-93(Apr. 1969).

An Orbiting Geophysical Observatory (OGO) experiment is described for monitoring the cosmic-ray neutron flux over a large region of space near the earth for an extended time with a simple neutron monitor. The basic detecting system to measure the integrated neutron flux from 10^{-8} to 15 MeV consists of a moderated ^{3}He proportional counter surrounded by a charged-particle rejection system. A plastic scintillator viewed by a photomultiplier is operated in coincidence with the neutron counter to determine the energy spectrum and flux in the 1 to 10 MeV range. To minimize contributions from neutrons produced within the OGO spacecraft, the sensor is located about 4.5 m out on the EP-5 boom. The experiment includes an in-flight calibrator to check pulse discriminator levels on neutron and charged-particle channels and a calibration-loop system to compensate for changes in the photomultiplier gain. The mean neutron detection efficiency for the expected neutron energy spectrum over the energy range 10^{-8}–15 MeV is 1.8 cm^2. The weight of the neutron sensor is 2.58 kg, with a length of 0.314 m and a dia of 0.111 m. The total power requirements are 4.5 W. The sensor has a background counting rate of <0.04/sec, which is <25% of the lowest counting rate expected near the equator. Hence, the latitude, longitude, and altitude dependence of the integrated neutron flux can be measured. (BBB)

48767 BALLOON OBSERVATIONS OF COSMIC X RAYS IN THE ENERGY RANGE 20 TO 200 keV. Rangan, K. Kasturi; Bhavsar, P. D.; Nerurkar, N. W. (Physical Research Lab., Ahmedabad, India). J. Geophys. Res., 74: 5139-44(Oct. 1, 1969).

A balloon-borne scintillation telescope was flown on March 31, 1968, from Hyderabad, India, to measure the isotropic component of the cosmic x rays. The spectrum of the primary diffuse x rays in the 20 to 130 keV interval is found to be 140 $E^{-2.4\pm0.4}$ photons cm^{-2} sec^{-1} ster^{-1} keV^{-1}. The results of other observers are compared with those obtained in this experiment. (auth)

48768 SOLAR MODULATION OF COSMIC ELECTRONS AND NUCLEI. Sakai, Takasuke (Nagoya Univ., Japan). Rep. Ionosphere Space Res. Jap., 23: Nos. 1-2, 55-74(1969).

Observed energy spectra of cosmic-ray protons, helium nuclei and electrons in the period near minimum solar activity are satisfactorily interpreted under the assumptions that the cosmic-ray intensities are modulated by the betatron deceleration mechanism operating in interplanetary space and that the unmodulated energy spectra of cosmic rays (i.e., the spectra outside the region of solar modulation) obey the power law in total energy. Theoretical curves based on the betatron deceleration model show good agreement with all the observed spectra of the three components of cosmic rays, whereas those based on other models including Parker's diffusion–convection model do not agree with the observed electron spectra in the range 3 MV to 200 GV as far as the common shape of the unmodulated spectrum is assumed for three components. Unmodulated spectra of the power law in total energy are found to be in better agreement with the observations than those of the power law in rigidity. The value of $P_0 \cong 0.1$ GV is obtained to give the best fit between the experimental and the theoretical energy spectra of cosmic rays. Comparison of this value with the change of the power spectrum of the magnetic field irregularities observed in interplanetary space also supports the betatron model. Experimental results of the time variation of the electron intensity, the relative fractional changes of the proton and electron components, R(p/e) and the cosmic-ray intensity gradient in interplanetary space are compared with the theoretical consequences of the betatron deceleration model and are found to be consistent with each other. (auth)

48769 AEOLOTROPY OF SHORT-CYCLE CHANGE IN INTENSITY OF COSMIC RAYS. Komori, Hiroo (Yamanashi Univ., Kofu, Japan). Yamanashi Daigaku Gakugeigakubu Kenkyu Hokoku, No. 19, 242-4(1968). (In Japanese).

During comparison of experimental and theoretical curves of the intensity changes of cosmic rays the anisotropy of cosmic rays in the interplanetary space was investigated with regard to the latitude of original direction, the angular distribution function, and the intensification, considering such parameters as responsive function, asymptotic direction, variation spectra, and diurnal changes. It was found by analyzing the measured data on Mar. 24, 1966, that the angular distribution was shown by a cosine function, $f(\theta) = (\cos\theta + 1)/2$, and that the original latitude was 80°S. (NSA of Japan)

48770 TIME VARIATIONS IN THE SOFT COMPONENT OF COSMIC RAYS. Kawasaki, Shinkichi. Sci. Pap. Inst. Phys. Chem. Res. (Jap.), 63: 19-24(June 1969).

Several features of the time variations of cosmic-ray soft component observed at sea level over seven years from 1958 to 1964 are presented. The atmospheric absorption coefficient obtained is −0.34%/mb. The yearly mean solar diurnal and semi-diurnal variations of soft component are compared with those of the neutron and hard components. On the harmonic diagrams, the harmonic vector of soft component is always behind in phase and the vectors of the soft and hard components are situtated on the opposite sides of the vector of the neutron component. It is interpreted by the appearance of the positive temperature effect in the soft component as well as the negative temperature effect in the hard component. On the contrary, there is essentially no seasonal variation in the soft component. It indicates that the positive and negative temperature effects are completely balanced as pointed out by

Dorman. In the cases of the eleven-year variation and Forbush events, the amounts of variation are equal to those of the hard component. It means that the response functions for both components are almost the same. (auth)

48771 ACCESS OF SOLAR PROTONS INTO THE POLAR CAP: A PERSISTENT NORTH-SOUTH ASYMMETRY. Evans, L. L. C.; Stone, E. C. (California Inst. of Tech., Pasadena). J. Geophys. Res., 74: 5127-31(Oct. 1, 1969).

Before the magnetic storm sudden commencement during the November 2, 1967, solar-particle event, the access of 1.2- to 40-MeV protons into the high-latitude portion of the northern polar region was delayed by ~20 hours. At the same time the access delay for 10- to 40-MeV protons was ≲1 hour in the southern polar region and at middle northern latitudes. The implications of the north–south asymmetry are discussed. (auth)

48772 SOLAR MODULATION OF GALACTIC COSMIC RAYS. I. Fisk, L. A.; Axford, W. I. (Univ. of California, San Diego, La Jolla). J. Geophys. Res., 74: 4973-86(Oct. 1, 1969).

The equations governing cosmic-ray modulation allowing for convection, diffusion, and energy changes are approximated with simpler, more manageable equations that describe the particle behavior in a limited energy range. One of these equations determines an excellent approximation to the particle number density in the limit when the particles undergo relatively little modulation or equivalently when $\vec{V}\vec{r}/\vec{\kappa} \leq 1$, where $\vec{V}$, $\vec{r}$, and $\vec{\kappa}$ are characteristic values of the solar wind speed, the heliocentric distance, and the diffusion coefficient, respectively. This equation describes the behavior of particles with energies above a few hundred MeV/nucleon. Other approximate equations describe the behavior of the number density and radial streaming when $\vec{V}\vec{r}/\vec{\kappa} \gtrsim 3$, a condition which should be satisfied at energies below about 50 to 75 MeV/nucleon. Analytic solutions to the exact equations for the number density and streaming are given for cases in which the diffusion coefficient has the form $\kappa = \kappa_0 T^a r^b$, $(b > 1)$, where r is heliocentric distance and T is particle kinetic energy. These solutions are used to demonstrate that the approximate equations accurately describe the particle behavior in their respective limits. (auth)

48773 A MEASUREMENT OF THE SPECTRUM OF COSMIC-RAY ELECTRONS BETWEEN 20 MeV AND 3 BeV IN 1968. FURTHER EVIDENCE FOR EXTENSIVE TIME VARIATIONS OF THIS COMPONENT. Rockstroh, J.; Webber, W. R. (Univ. of Minnesota, Minneapolis). J. Geophys. Res., 74: 5041-53(Oct. 1, 1969).

The intensity and spectrum of cosmic-ray electrons from 20 MeV to 3 BeV were measured at a depth of 2.5 g/cm^2 at Fort Churchill in the summer of 1968 at a time when solar modulation effects had reduced the sea-level neutron monitor rate by ~12% below its sunspot minimum value. The instrument used was identical to that used in previous flights to study electrons at this location in 1965 and 1966. The total electron intensity at 2.5 g/cm^2 atmospheric depth at energies ≳1.5 BeV in 1968 was essentially the same as that observed in 1966, however, at lower energies the intensity was greatly reduced in 1968. This reduction was a factor of 4 in the 200- to 400-MeV range. Atmospheric growth curves were used to determine the contribution of atmospheric secondary electrons. The deduced extraterrestrial electron intensity appears to be a factor ~5 lower in 1968 than in 1966 at energies just above 200 MeV. At higher and lower energies the fractional decrease becomes less. These results confirm and extend earlier measurements of the solar modulation of electrons made in 1965–1966. The energy dependence of the electron modulation is essentially the same in the 1966–1968 period as was measured in 1965–1966. (auth)

Direct Energy Conversion

Refer also to abstracts 48317, 48365, 48477, and 48478.

48774 (GA-9163) PERFORMANCE EVALUATION OF A THERMIONIC CONVERTER USING A GRAPHITE INTEGRAL RESERVOIR. Gietzen, A. J. (Gulf General Atomic, Inc., San Diego, Calif.). Apr. 16, 1969. Contract AT(04-3)-167. 22p. Dep. CFSTI.

An analytical evaluation of a graphite integral reservoir as a cesium supply in a thermionic converter is described. The reservoir is thermally coupled to the emitter and collector such that its temperature is determined by the electrode temperatures. The collector temperature depends in a passive manner on the thermal power rejected. The thermal model of the converter and reservoir is presented. The analysis includes performance obtained with specific designs incorporating the reservoir into the converter. The current–voltage characteristics are computed over the entire range of input power from startup to full power. The results indicate that close coupling of the graphite reservoir to the collector causes a peak in emitter temperature in the input power range of 30 to 60% of full power, resulting from inadequate cesium coverage for good electron emission. The difficulty can be overcome by incorporating a small amount of control (±50°K) on collector temperature, or by increasing the reservoir thermal coupling to the emitter. The ability to maintain near-optimum cesium pressure through large variations in output power is investigated and found to require strong thermal coupling to the emitter. Performance losses due to changes in the thermal coupling characteristics are calculated. (auth)

48775 (N-69-32553) CHARACTERISTICS OF A THERMIONIC CONVERTER WITH A CHLORIDE VAPOR DEPOSITED TUNGSTEN EMITTER (110) AND A NICKEL COLLECTOR. Wilson, V. C.; Podkulski, S. P. (General Electric Co., Schenectady, N. Y. Research and Development Center). Aug. 1969. Contract NAS3-8511. 37p. (NASA-CR-1416; GESP-9001). CFSTI.

A chloride vapor-deposited (110) tungsten emitter with a vacuum work function of 4.96 eV was built into a 0.005-inch-spaced converter with a nickel collector. The I–V curves for emitter temperatures of 1673 to 2153°K are presented. The output power versus emitter temperature is compared with three other similar converters. This converter yielded almost the same output power as a converter with a single-crystal (110) tungsten emitter, 0.002-inch spacing, and a molybdenum collector. The vapor-deposited (110) tungsten surface was found to be extremely stable. The collector work function was observed to decrease when the device was left at room temperature for one month. (auth) (STAR)

48776 THE DETERMINATION OF THE ELECTRICAL CONDUCTIVITY OF THE GASES IN A PILOT-SCALE COAL-FIRED MAGNETOHYDRODYNAMIC COMBUSTOR. English, P. E.; Rantell, T. D. (British Coal Utilisation Research Association, Leatherhead, Eng.). J. Phys., D, 2: 1215-24(Sept. 1969).

The electrical conductivity of a potassium-seeded gas from a pilot-scale coal-fired magnetohydrodynamic combustor was measured in a conductivity duct, the operation of which was such that allowance could be made for the effects of molten slag flowing through it. The mode of operation and the calculation of the conductivity of the seeded gas are described. Comparison of the measured and calculated data indicates that conductivities can be predicted for the combustion conditions considered. (auth) (UK)

48777 ANALYSIS OF AN MHD GENERATOR WITH WAVE ELECTRIC CONDUCTIVITY AT SMALL MAGNETIC REYNOLDS NUMBER. Zaklyaz'minskii, L. A.; Katsnel'son, S. S. Magn. Gidrodin., Akad. Nauk Lat. SSR, No. 1, 77-85(Jan.-Mar. 1969). (In Russian).

An analysis is given of axially symmetric nonstationary interaction of a gas with a constant magnetic field and a field of given electric contour in the region of small Reynolds numbers. The flow of the gas in the zero approximation of Reynolds number was assigned in the form of an entropy wave, i.e., when pressure and gas velocity are constant and temperature and electric conductivity are the arbitrary functions of gas particle coordinates. (tr-auth)

48778 EXPERIMENTAL INVESTIGATION OF THE SHUNTING EFFECT OF CONDUCTING WALLS OF A CHANNEL IN A FLAT INDUCTION MHD MACHINE. Okhremenko, N. M. Magn. Gidrodin., Akad. Nauk Lat. SSR, No. 1, 91-8(Jan.-Mar. 1969). (In Russian).

Methods and experimental results are presented, confirming the influence of channel walls on the magnitude of electromagnetic pressure developed by a flat linear-induction magnetohydrodynamic machine of limited width. The machine has a rectangular cross section 180 × 12 mm^2. The wide walls were prepared from sheet copper with a thickness of 2 mm. The machine was included in succession with a more powerful induction pump in the mercury circuit, was fed by a current with a frequency of 25 or 50 cycles, and worked in pump and brake regimes. (tr-auth)

48779 ESTIMATES OF FIELDS IN FLAT LINEAR-INDUCTION MHD MACHINES WITH CONSIDERATION OF FINITE THICKNESS OF WINDING ZONES AND THE MAGNETIC POROSITY OF IRON. Birger, B. L.; Vilnitis, A. Ya.; Gorovits, V. S. Magn. Gidrodin., Akad. Nauk Lat. SSR, No. 1, 105-10(Jan.-Mar. 1969). (In Russian).

It is shown that by combination of fields with different electric and magnetic properties for various boundary conditions it is possible to obtain mathematical models of different MHD machines. The winding zone is considered a field that possesses continuous structure with electric and magnetic anisotropy. A general

mathematical model consisting of 13 zones was used. Field equations are given and boundary conditions described for all zones. (M.C.G.)

48780 ESTIMATES OF ELECTRIC POTENTIALS FOR ONE MODEL OF A CONDUCTING MHD INSTALLATION. Zander, Yu. K. Magn. Gidrodin., Akad. Nauk Lat. SSR, No. 1, 121-8 (Jan.-Mar. 1969). (In Russian).

The potential was calculated for an external electric field in a rectangle adjacent to an infinite band with different conductivities. A transverse magnetic field of induction was superimposed, which was proportional to the density of current of the applied potential, and expressions were found for the potential of electric fields induced when the band slips along the conducting rectangle. The solutions for Laplace and Poisson equations were obtained and are expressed in the form of endless orders according to trigonometric and hyperbolic functions. (M.C.G.)

48781 LIQUID METAL POWER GENERATOR. 2. Chandrasekhara, B. C.; Kuchela, K. N.; Rudraiah, N. (Bangalore Univ., India). Curr. Sci. (India), 38: 381-2(Aug. 20, 1969).

The variation of density with height and its effect on the current and efficiency of a liquid-metal MHD generator are discussed. The equivalent circuit of the generator and expressions for open-circuit voltage, terminal voltage, and short-circuit current are included. (M.H.R.)

48782 THERMODYNAMICS OF A MULTISTAGE FLUID-ACCELERATING DEVICE. Kozlov, V. B.; Tsiklauri, G. V. Heat Transfer–Sov. Res., 1: No. 4, 71-6(July 1969).

A great deal of attention has been paid lately to the theory of all kinds of accelerating devices for MHD facilities with a liquid-metal working fluid. In all the known schemes the working fluid is accelerated by partially vaporizing it, which requires elimination of the vapor phase of the inlet to the MHD generator, due to conductivity requirements. In the cycle with elimination of the vapor phase through liquefaction by mixing, the greatest losses take place due to the difference in the velocities of the two-phase steam and cold-fluid flow. Despite the published studies on the theory of multistage mixing as a method of reducing impact losses, the problem of such a kind of accelerating device for MHD facilities has not been sufficiently studied. Thermodynamic analysis of multistage mixing shows that the efficiency which is obtained depends on the method of distribution of useful enthalpy difference and masses of the cold liquid among the injector stages. The injector efficiency decreases with an increase in the initial quality of the cycle; here the outlet velocity increases, passes through a maximum and decreases again. As the number of stages is increased, the injector efficiency improves. When operating an injector using saturated high-quality steam, use should be made of a larger number of stages than for lower-quality steam. (auth)

48783 TRANSVERSE AND LONGITUDINAL BOUNDARY EFFECTS IN AN MHD CHANNEL OF RECTANGULAR CROSS SECTION. Nemkova, N. G. Zh. Prikl. Mekh. Tekh. Fiz., No. 4, 3-13(July-Aug. 1969). (In Russian).

The three-dimensional distribution of the electric field during a steady isotropic conducting fluid flow in an MHD channel with a semi-infinite electrode is analyzed, and the Joule heating, power, and efficiency of the generator are calculated. (R.V.J.)

48784 INFLUENCE OF RADIATION TRANSPORT ALONG THE RELAXATION LENGTH IN A CLOSED-CYCLE MHD GENERATOR. Biberman, L. M.; Kas'yanov, V. A. (Inst. of High Temperature, Moscow). Teplofiz. Vys. Temp., 7: 783-5(July-Aug. 1969). (In Russian).

The influence of radiation transport on the length of the ionization relaxation zone in an MHD generator channel was estimated for: R = 5 cm, T = 1600°K, and working medium of quasi-neutral K–Ar plasma. Data obtained showed that the ionization relaxation length is equal to 7 cm, much shorter than the earlier reported published values. (R.V.J.)

48785 VOLT–AMPERE CHARACTERISTICS (HALL VOLTAGE–HALL CURRENT) IN NONEQUILIBRIUM AND INHOMOGENEOUS PLASMA. Aberkova, D. M.; Lopatskii, G. S. (Inst. of High Temperature, Moscow). Teplofiz. Vys. Temp., 7: 782-3(July-Aug. 1969). (In Russian).

An attempt was made of calculating the Hall volt–ampere characteristics in a nonequilibrium plasma appearing with the development of steady-state laminar plasma heterogeneities. The examined volt–ampere characteristics are a model for loading characteristics for an MHD Hall generator with a developed plasma ionization instability. Calculations were made with an argon–potassium plasma (potassium content near 0.1%, argon at atmospheric pressure and $(T_{e\,max} = 3500°K)$. The stability of nonequilibrium plasma stationary states were calculated for the case in which $\langle j_x \rangle = 0$, $\Omega_e \tau_{ei} = 10$. The volt–ampere characteristics calculated were in good agreement with analogous characteristics previously obtained experimentally with MHD generator. (R.V.J.)

Fluid Physics

Refer also to abstracts 48783 and 48784.

48786 EXPERIMENTAL INVESTIGATION OF THE INFLUENCE OF TRANSVERSE MAGNETIC FIELD ON THE FLOW IN A CHANNEL WITH ELECTRODES. Vasil'ev, A. S.; Teplyakov, V. A. Magn. Gidrodin., Akad. Nauk Lat. SSR, No. 1, 141-3 (Jan.-Mar. 1969). (In Russian).

Results are given of an experimental investigation of the distribution of pressure along the length of a channel with electrodes parallel to the transverse magnetic field. The studied flow was close to plane-parallel. The experiments were conducted in the following regimes: in the absence of magnetic fields, in a regime of blank flow, and in a generator regime at a certain definite external resistance. It was established that with an increase in induction of the external magnetic field the pressure gradient is increased. This increase was especially noticeable near the ends of electrodes. (tr-auth)

48787 EFFECT OF VELOCITY CURVE ON THE ELECTRIC FIELD INDUCED BY FLOW OF ELECTRICALLY CONDUCTING LIQUIDS IN A CIRCULAR CHANNEL IN A SCATTERING FIELD OF A UNIDIRECTIONAL INDUCTOR. Bol'shakov, V. B.; Korsunskii, L. M. Magn. Gidrodin., Akad. Nauk Lat. SSR, No. 1, 111-16 (Jan.-Mar. 1969). (In Russian).

The influence of the distribution of velocities near the walls in a circular channel in an electric field on the flow of an axially symmetric electrolyte in the magnetic field of a specially shaped inductor, installed on the external wall of the channel, was considered. Dynamic effects and deformation of the magnetic field were neglected. (tr-auth)

48788 HEAT AND MASS TRANSFER IN MAGNETIC FIELDS. Mikhailov, Yu. A. Magn. Gidrodin., Akad. Nauk Lat. SSR, No. 1, 3-10(Jan.-Mar. 1969). (In Russian).

The main directions of development of magnetohydrodynamics are considered and their use in studies of heat and mass transfer processes discussed. The influence of magnetic fields on heat and mass transfer is illustrated for MHD flow of an incompressible liquid. The existence of an analogy between heat transfer and isothermal mass transfer was substantiated. The peculiarities of the MHD flow of two-phase electrically conducting systems in channels and the transfer phenomena that occur in them are shown. (tr-auth)

48789 MATRIX FORM OF MAGNETOHYDRODYNAMIC EQUATIONS. Demutskii, V. P.; Polovin, R. V. Magn. Gidrodin., Akad. Nauk Lat. SSR, No. 1, 11-15(Jan.-Mar. 1969). (In Russian).

The equations of one-dimensional magnetohydrodynamic flow are represented in matrix form. This permits the compact recording of the ratio between different magnetohydrodynamic magnitudes in linear and plane waves and expression of profiles of shock waves of small intensity. Various magnetohydrodynamic magnitudes may be determined from the right eigenvector of the matrix and dissipation of amplitude and structures of shock waves from the left eigenvector. (tr-auth)

48790 ESTIMATION OF THE FLOW OF AN IONIZED GAS IN A MAGNETOHYDRODYNAMIC CHANNEL OF RECTANGULAR CROSS SECTION. Apollonskii, S. M.; Evgrafov, V. V.; Kos'kin, Yu. P. Magn. Gidrodin., Akad. Nauk Lat. SSR, No. 1, 29-34 (Jan.-Mar. 1969). (In Russian).

Methods of estimating magnetogasdynamic flow in channels on the basis of the quasi-one-dimensional approach are considered. Calculations of pre-electrode drops in potential were carried out using equations for pre-electrode layers. The decrease in effective cross section of the channel with length because of boundary layers was also taken into account. The satisfactory convergence of experimental data and estimates indicated the possibility of utilization of the proposed method for engineering estimates of rectangular MGD channels. (tr-auth)

48791 INFLUENCE OF AN INDUCED MAGNETIC FIELD ON THE MAGNETOHYDRODYNAMIC FLOW OF COMPRESSED GAS. Zimin, E. P.; Eismont, O. A. Magn. Gidrodin., Akad. Nauk Lat. SSR, No. 1, 35-9(Jan.-Mar. 1969). (In Russian).

The stationary one-dimensional flow of nonviscous, non-heat-transferring, conducting, compressed gas in crossed electric and magnetic fields is considered. Approximate analytical equa-

tions were obtained from an initial system of equations for regimes close to blank flow in a homogeneous electric field without the limitation of the magnitude of the magnetic Reynolds number. The relation of the integral characteristics of the transposition to Reynolds number was analyzed for three plans for closing the current in the external chain. (tr-auth)

48792 CERTAIN NEW RULES IN THE THEORY OF LONGITUDINAL END EFFECTS IN MHD CHANNELS AT ARBITRARY MAGNETIC REYNOLDS NUMBERS. Kozyrenko, V. E. Magn. Gidrodin., Akad. Nauk Lat. SSR, No. 1, 40-8(Jan.-Mar. 1969). (In Russian).

On the basis of the method of successive approximations, essentially using transition to two complexly conjugated arguments, the effective analytical equation for regional problems is given, describing in the first approximation the two-dimensional distributions of an electromagnetic field in MHD channels with final electrodes at arbitrary Reynolds numbers, a given field, and stepwise changes in conductivity in relation to the method of closing of electrodes of the channel on load. Results are illustrated graphically. (tr-auth)

48793 MAGNETOHYDRODYNAMIC FLOW IN A ROTATING TORUS. Kushel, G. Magn. Gidrodin., Akad. Nauk Lat. SSR, No. 1, 49-60(Jan.-Mar. 1969). (In Russian).

Experimental and theoretical investigations were conducted on mercury flow in a rotated low-friction torus under the action of induction pump force and magnetic field. The following questions were studied: the effort of the induction pump in the curved channel, the coefficient of the resistance as a function of the Reynolds number and the rotation parameters, the influence of the magnetic field on the resistance to flow of the mercury in the channel, and the influence of constant time for steric periodic field on resistance to flow. By application of the theorem of conservation of moment of movement, the average velocity of mercury in the rotated torus was determined. (tr-auth)

48794 TURBULENT HARTMANN FLOW. Branover, G. G.; Gel'fgat, Yu. M.; Peterson, D. A.; Tsinober, A. B. Magn. Gidrodin., Akad. Nauk Lat. SSR, No. 1, 61-7(Jan.-Mar. 1969). (In Russian).

Results of theoretical and experimental investigations of the turbulent flow between parallel smooth planes in the presence of an external magnetic field parallel to these planes are presented. Theoretical estimates were carried out on the basis of a semi-empirical theory, which considers the influence of the magnetic field on the method of mixing in the Prandtl equation for the turbulent tangent intensity. Experimental investigations included measurements of profiles of stream velocity, which is similar to flat parallel flow. (tr-auth)

48795 PULSATING FLOW OF A CONDUCTING LIQUID IN A PLANE CHANNEL. Dzhaugashtin, K. E.; Mintsberg, B. L. Magn. Gidrodin., Akad. Nauk Lat. SSR, No. 1, 71-3(Jan.-Mar. 1969). (In Russian).

Equations were developed for the laminar flow of an incompressible conducting liquid in a flat channel in a crossed magnetic field under the action of a pressure drop, pulsating relative to the average value. The influence of the amplitude and the frequencies of oscillations on the resistance of the channel and the influence of the magnetic field on the intensity of the pulsations were analyzed. (tr-auth)

48796 RETARDATION OF FREE UNSUBMERGED JETS IN A PERPENDICULAR MAGNETIC FIELD. Eliseev, B. V.; Lobanov, A. D. Magn. Gidrodin., Akad. Nauk Lat. SSR, No. 1, 74-6 (Jan.-Mar. 1969). (In Russian).

A system was obtained for describing, in a one-dimensional approximation, the flow of free unsubmerged jets perpendicularly to an applied magnetic field. The induced magnetic field is neglected. Boundary conditions must be prescribed for the equations of the one-dimensional system. The obtained distribution of velocity along the axis of the jet was compared with experimental values. A qualitative coincidence of theoretical and observed velocity profiles for the movement of the jet of liquid in a channel filled by the same liquid was observed. (tr-auth)

48797 FLOW OF A CONDUCTING FLUID BETWEEN POROUS DISKS FOR LARGE-SUCTION REYNOLDS NUMBER. Rudraiah, N.; Chandrasekhara, B. C. (Bangalore Univ., India). J. Phys. Soc. Jap., 27: 1041-5(Oct. 1969).

The magnetohydrodynamic laminar flow between two parallel porous disks is examined for large-suction Reynolds number and arbitrary Hartmann number. The equations of motion are solved using the singular perturbation technique and the expressions for the velocity, pressure and shear stress distributions are obtained. The results of this analysis are compared with the case of large-injection Reynolds number. (auth)

48798 THE EFFECT OF HALL CURRENTS ON THE MAGNETOHYDRODYNAMIC BOUNDARY LAYER FLOW PAST A SEMI-INFINITE FLAT PLATE. Katagiri, Masakazu (Yamagata Univ., Japan). J. Phys. Soc. Jap., 27: 1051-9(Oct. 1969).

The effect of Hall currents on the steady boundary-layer flow of an incompressible, viscous, and electrically conducting fluid past a semi-infinite flat plate in the presence of a transverse magnetic field is investigated with the assumption of small magnetic Reynolds number. The numerical solutions of boundary-layer equations are obtained by the difference–differential method originated by Hartree and Womersley with an iterative method in solving resulting differential equations. The velocity profiles and the skin friction on the flat plate are computed for various values of the Hall parameter. Hall currents induce the flow and the skin friction in the cross direction. The effect of Hall currents, especially on the skin friction, is examined in detail. (auth)

48799 ON THE SEPARATION OF MAGNETOHYDRODYNAMIC FLOW NEAR THE REAR STAGNATION POINT. Katagiri, Masakazu (Yamagata Univ., Japan). J. Phys. Soc. Jap., 27: 1045-50(Oct. 1969).

In order to examine the separation of a magnetohydrodynamic boundary layer, the development of the flow started from rest near the rear stagnation point in the presence of an applied magnetic field normal to a wall is considered as in the nonmagnetic case on the assumption of small magnetic Reynolds number. An attempt is made to solve the equations governing the flow by series expansion in an unsteady parameter and series solutions are obtained in the form of an integral. The skin friction up to the sixth-order approximation, calculated by numerical quadratures, indicates that separation delays as N increases from zero ($N = SR_m$, where S is the pressure number and R_m the magnetic Reynolds number) and when $N \cong 1.2$, separation is seen to be completely inhibited. (auth)

48800 HEAT TRANSFER DURING THE FLOW OF A CONDUCTING FLUID IN A MAGNETIC FIELD. A REVIEW. Vartazarov, I. S. Heat Transfer–Sov. Res., 1: No. 4, 231-7(July 1969).

Theoretical and experimental studies by a number of investigators of heat transfer in a conducting fluid flowing in transverse and longitudinal magnetic fields are reviewed. It emphasizes the principal difference in the effect of the magnetic field on the heat transfer as a function of the flow variables. (auth)

48801 MAGNETOHYDRODYNAMIC FLOW PAST AXISYMMETRIC BODIES WITH ALIGNED MAGNETIC FIELD. Parbhakar, Kanwal J. (Trent Univ., Peterborough, Ont.); Uberoi, Mahinder S. Phys. Fluids, 12: 283-9(Oct. 1969).

The steady axially symmetric flow of an inviscid incompressible fluid of small conductivity, embedded in a strong magnetic field, past fixed bodies is studied as a problem of finite perturbation. The magnetic Reynolds number is assumed small so that the magnetic field is unperturbed. The flow depends on the parameter β which is proportional to the product of conductivity and the square of the magnetic field strength. The flow past a semi-infinite body and a sphere is numerically calculated and the solution indicates that the effect of the body is felt upstream. This upstream influence is convected by the flow and appears as a nondiffusive boundary layer and a wake for the semi-infinite body and the sphere, respectively. The drag and the various boundary layer and wake characteristics decrease with β. The classical Bernoulli function $\mathcal{H}$ ($=p + \frac{1}{2}u^2$) decreases along streamlines and the pressure distribution on the surface of the bodies changes appreciably from the corresponding nonmagnetic value. (auth)

48802 VARIATIONAL PRINCIPLE IN MAGNETOHYDRODYNAMICS. Merches, Ioan (New York Univ., N. Y.). Phys. Fluids, 12: 2225-7(Oct. 1969).

By using a special set of electromagnetic field potentials and an appropriate Lagrangian density, the momentum equation for a compressible, inviscid, infinitely conducting fluid undergoing isentropic motion in an electromagnetic field is obtained. (auth)

48803 MAGNETOHYDRODYNAMIC FLOW IN A CYLINDRICAL SECTORIAL CROSS SECTION CHANNEL. Pavlov, K. B.; Fedotov, I. A. Izv. Akad. Nauk SSSR, Mekh. Zhidk. Gaza, No. 4, 128-31(July-Aug. 1969). (In Russian).

Velocity distribution and magnetic induction of incompressible conducting fluid flow in a cylindrical sectorial cross section channel with nonconducting walls were found in the presence of longitudinal linear current. (R.V.J.)

48804 ON HEAT TRANSFER IN CROSSED-FIELD MHD CHANNEL FLOW BETWEEN CONDUCTING WALLS. Soundalgekar, V. M. (Indian Inst. of Tech., Bombay). Proc. Nat. Inst. Sci. India, Part A, 135: 329-42(Mar. 1969).

A study of heat transfer aspect of fully developed flow in MHD channel under crossed fields is presented. Closed-form solutions for the temperature θ, Nusselt number Nu, and the mean mixed temperature T_{im} are obtained under the following two conditions: (1) Walls at different temperatures. (2) Linear variation of temperature along the walls. Numerical values for θ, Nu, T_{im} are carried out for different values of M (the Hartmann number), e (the loading parameters), $\phi_u + \phi_t$ (sum of the electrical conductance ratios for the upper and lower walls respectively), and P_rRA (product of Prandtl number, Reynolds number and a non-dimensional number). Some of the important effects of these parameters on the temperature field are brought out during the course of discussion. (auth)

48805 STEADY MHD COUETTE FLOW BETWEEN TWO CONDUCTING WALLS OF AN ELECTRICALLY CONDUCTING, VISCOUS, INCOMPRESSIBLE RAREFIED GAS. Soundalgekar, V. M. (Indian Inst. of Tech., Bombay). Proc. Nat. Inst. Sci. India, Part A, 135: 251-61(Mar. 1969).

An investigation of the combined influence of magnetic field and electrically conducting walls on laminar, steady MHD Couette flow of an electrically conducting, incompressible, viscous, rarefied gas is carried out, in slip-flow regime under first order slip boundary conditions. It is observed that the flow field is completely affected by the rarefaction of the gaseous medium. Velocity profiles, magnetic field profiles, current density, rate of mass flow, and viscous drag are presented graphically under different conditions and the numerical values of the magnetic drag coefficient, velocity-gradient, slip-velocity, and center line velocity are entered in tables. Some important conclusions are presented. (auth)

Geophysics (Upper Atmosphere)

Refer also to abstracts 48749 and 49019.

48806 (AD-689835) MAGNETOSPHERE. Final Report (Part 2), January 1, 1965-June 30, 1968. Ferraro, V. C. A.; Kendall, P. C. (Sheffield Univ. (England). Dept. of Applied Mathematics and Computing Science). May 1, 1969. 14p. (AFCRL-69-283). CFSTI.

Recent theoretical work, related to semi-idealized problems of the magnetosphere, carried out at Queen Mary College, University of London, and the University of Sheffield, is reported. The research outlined here concerns: centrifugal effects of plasma flow round the magnetosphere; steady and unsteady dynamics of a two-dimensional model of the magnetosphere; Legendre polynomial expansion of the magnetic field of a ring current composed of spiraling trapped particles including nonlinearity; and the neutral sheet in the geomagnetic tail. (auth) (USGRDR)

48807 (AD-690191) DAYTIME D- AND E-REGION CHEMISTRY. Niles, Franklin E. (Ballistic Research Labs., Aberdeen Proving Ground, Md.). Apr. 1969. 31p. (BRL-MR-1974). CFSTI.

A brief description of daytime chemistry of the D and E regions of the ionosphere is presented. Included are the vapor-phase reactions that lead to the observed hydrated positive ions in the D region. (auth) (USGRDR)

48808 (AD-690530) COLUMNAR ELECTRON CONTENT AND D-REGION IONIZATION STUDIES WITH 100 kHz TO 41 MHz DATA. Final Report, November 1, 1964-February 29, 1968. Reinisch, Bodo W.; Bibl, Klaus; Olson, Kirtland H. (Lowell Technological Inst., Mass. Research Foundation). Mar. 1, 1968. Contract AF19(628)-4784. 101p. (LTIRF-284/IP; AFCRL-68-647). CFSTI.

At Weston, Massachusetts (42° N, 71° W) satellites BE-B and BE-C, providing both north-south and east-west passes, were observed on frequencies of 20, 40, and 41 MHz. Fourteen independent signal-amplitude and phase parameters contained Doppler shift, Faraday rotation, and incidence angle measurements that were analyzed with new methods to obtain reliable values of the ionospheric electron content. For ionospheric D-region studies a coordination of different theoretical approaches and experiments was attempted including construction of a Loran-C receiving system which has been used for reception at 300 kHz during an eclipse in Brazil. (auth) (USGRDR)

48809 (N-69-30749) CHARACTERISTICS OF THE X-RAY EMISSIONS ASSOCIATED WITH SOLAR PROTON FLARES. Sakurai, Kunitomo (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). June 1969. 9p. (NASA-TM-X-63600; X-615-69-269). CFSTI.

Sudden ionospheric disturbances such as SWF, SEA, SPA, and others are usually associated with solar proton flares. These disturbances are generated by enhanced ionization of the lowest part of the ionospheric D region due to the incidence of energetic x rays. (auth) (STAR)

48810 (N-69-30823) MULTI-EXPERIMENT DETECTION OF THE PLASMAPAUSE FROM EOGO SATELLITES AND ANTARCTIC GROUND STATIONS. Carpenter, D. L.; Park, C. G.; Taylor, H. A. Jr.; Brinton, H. C. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Sept. 1968. Contract NAS5-2131. 24p. (NASA-TM-X-63602; X-621-68-365). CFSTI.

Three independent methods of detecting the plasmapause are compared: (1) ion mass spectrometers on OGO 1 and OGO 3; (2) broadband vlf receivers (0.3 to 12.5 kHz) on OGO 1 and OGO 3; and (3) broadband vlf receivers at ground stations in Antarctica near the 90°W meridian. In the satellite vlf data the plasmapause crossings are identified by abrupt changes in observed whistler and vlf noise activity, and by noise bands of limited duration. In two cases of simultaneous vlf and ion data from the same EOGO satellite, plasmapause crossings were detected by both experiments within less than 0.1 R_E in L value. In eight cases of OGO 1 ion data and simultaneous ground whistler data spaced from 1 to 12 hours from OGO 1 in local time, good agreement was found between the measured plasmapause positions. The comparisons provide new verification of the essentially worldwide extent of the plasmapause, and also verify previous indications that the radius of the plasmapause is frequently about constant over large local-time sectors. (auth) (STAR)

48811 (N-69-32285) WHISTLER PROPAGATION AND INSTABILITY CHARACTERISTICS. Lee, Joseph C. (Stanford Univ., Calif. Inst. for Plasma Research). May 1969. 169p. (NASA-CR-103572; SU-IPR-312). CFSTI.

A theoretical and experimental study of electromagnetic wave propagation in a homogeneous magnetoplasma was made. The mode of interest is right-hand polarized, propagating parallel to the magnetic field, and is known in ionospheric terminology as the whistler mode. The theory of its propagation is based on self-consistent solution of the Boltzmann equation with Maxwell's equations. By considering a series of electron velocity distributions, a comprehensive description of whistler propagation, damping, and instability characteristics was obtained. For isotropic distributions, it is shown theoretically that whistlers propagating parallel to the magnetic field are always stable, and can only suffer cyclotron (collisionless) damping. Both collisional and collisionless damping were analyzed and computed. Previous calculations of whistler damping are discussed. (auth) (STAR)

48812 (N-69-32883) WHISTLER PROPAGATION IN A BOUNDED MAGNETOPLASMA. Lee, J. C. (Stanford Univ., Calif.). May 1969. 29p. (NASA-CR-103671; SU-IPR-318). CFSTI.

For whistlers in bounded magnetoplasmas, there is a paradox; below half the electron cyclotron frequency, the wave propagation characteristics do not approach those of plane wave solutions in an unbounded magnetoplasma even when the plasma density is increased so that the wavelength is arbitrarily small compared to the plasma transverse dimensions. This results from the double reflection property of magnetoplasmas. Propagation characteristics in bounded plasma are related to the unbounded case by considering plane waves doubly reflected at the plasma boundary. As a by-product, limitations for the validity of the quasi-static approximation for body waves in bounded magnetoplasmas are established. (auth) (STAR)

48813 THEORY OF OXYGEN RED-LINE EMISSION. Tuan, T. F. (Univ. of Cincinnati). Astrophys. J., 157: 1449-54(Sept. 1969).

A general time-dependent formula was derived for the total intensity at zenith of the red oxygen line at 6300 Å of the night airglow. The formula takes specifically into account the variations in the shape of the profiles of electron density as a function of time; it reduces to the well-known Barbier formula when the distribution of electron density is shape-invariant. Luminosity profiles based on the atmospheric parameters at St. John's, Newfoundland, were also calculated for different times and were compared with the corresponding distributions of electron density. (auth)

48814 MEASUREMENTS IN THE IONOSPHERE OF THE ASPECT DEPENDENCE OF ANTENNA REACTANCE. I. VARIATIONS ARISING FROM THE INHOMOGENEOUS PLASMA DISTRIBUTION ABOUT THE VEHICLE. Stone, Robert G.; Fainberg, Joseph; Alexander, J. K. (Goddard Space Flight Center, Greenbelt, Md.). Planet. Space Sci., 17: 1437-47(Aug. 1969).

Measurements of antenna reactance from a sounding rocket

travelling through the ionosphere show variations related to the rocket spin period. The observed variations can be resolved into components with periodic time structure equal to the spin period, half the spin period, or a mixture of these. The relative importance of these components depends on the experiment configuration and the flight trajectory as well as on the magnetoionic parameters. To account for the observations, it is necessary to take into consideration the response of an antenna to the magnetoionic medium and to the disturbance produced in the ambient plasma by the rocket motion. Examples of the plasma distribution about the rocket, as inferred from the antenna reactance measurements, are shown and discussed. (auth) (UK)

48815 CONJUGATE AND CLOSELY SPACED OBSERVATIONS OF AURORAL RADIO ABSORPTION. I. SEASONAL AND DIURNAL BEHAVIOUR. Hargreaves, J. K. (Essa Research Labs., Boulder, Colo.). Planet. Space Sci., 17: 1459-84(Aug. 1969).

Results are given from nearly 2 yr of observation of auroral radio absorption at and around the magnetically conjugate stations Great Whale River and Byrd. By using spaced observations with riometers (the spacing being achieved with oblique antennas) it was possible to measure the spatial gradient of absorption as well as the amount of absorption over the station. Analysis of about 600 absorption events shows that although the relative positions of event centers in the two hemispheres (possibly to be identified with conjugate points) varies seasonally by 100 km or so, this is insufficient to affect significantly the ratio of absorption seen between fixed conjugate stations. Therefore the seasonal and diurnal variations of relative absorption between conjugate stations, reported previously, must indicate a hemispheric difference of particle precipitation or of D-region chemistry. The first of these seems the more likely. The seasonal and diurnal changes are delineated more exactly than hitherto, and a small seasonal variation in the geographic position of the absorption zone is reported. (auth) (UK)

48816 CONJUGATE AND CLOSELY SPACED OBSERVATIONS OF AURORAL RADIO ABSORPTION. II. CORRELATION PROPERTIES. Hargreaves, J. K. (ESSA Research Labs., Boulder, Colo.). Planet. Space Sci., 17: 1485-96(Aug. 1969).

Data on the auroral absorption events observed with riometers at and near the conjugate stations Great Whale River and Byrd are analyzed by means of correlation coefficients. The greatest correlation between conjugate regions, taking any displacement of conjugate point into account, is usually in the range 0.6 to 0.75; some, but not all, of the loss of correlation is attributed to a wandering of conjugate point by about 200 km. The analysis is unable to detect any loss of correlation as magnetic activity increases, although such a decrease has been reported in conjugate auroral observations by optical means. The difficulty of relating correlation patterns to the properties of the actual events is pointed out, with examples. (auth) (UK)

48817 LONG-TIME-SCALE MAGNETODYNAMIC NOISE IN THE GEOMAGNETIC TAIL. Hruska, A.; Hruskova, J. (Univ. of British Columbia, Vancouver). Planet. Space Sci., 17: 1497-1504(Aug. 1969).

Hourly ranges of the magnetic field in the Earth's magnetotail were determined from 5.46-min field averages measured by the IMP 1 satellite. The amplitude of fluctuations parallel to the local average field B decreased with increasing distance from the neutral sheet. The amplitude of fluctuations perpendicular to B decreased with increasing distance from the Earth. Fluctuations in two directions perpendicular to B (parallel and perpendicular to the neutral sheet) are coupled, but there is almost no evidence of a correlation between fluctuations parallel to B and fluctuations perpendicular to B. The tail field fluctuations observed in the vicinity of the Earth are well correlated with the geomagnetic activity measured by the K_p index. It is suggested that two independent types of noise exist in the geomagnetic tail. The first type corresponds to the disturbances propagating across the tail, perpendicular to B, and the second corresponds to disturbances propagating from the vicinity of the Earth along the tail field lines. (auth) (UK)

48818 AN EXPERIMENTAL SURVEY OF THE LOW-ENERGY ELECTRON SCATTERING SPECTRUM OF NITROGEN. Williams III, Albert J.; Doering, John P. (Johns Hopkins Univ., Baltimore). Planet. Space Sci., 17: 1527-37(Aug. 1969).

The electron energy loss spectrum of nitrogen was studied at incident energies from 9 to 50 eV with an electron spectrometer. Scattering angles from 4° to 30° were used. Energy resolution varied from 0.035 to 0.1 eV (FWHM). The spectra show that, at incident energies less than 20 eV, which are of greatest relevance to atmospheric processes, the energy loss spectrum is dominated by the electric quadrupole transition $X^1\Sigma_g^+ \rightarrow a^1\Pi_g$ and the spin-forbidden singlet-triplet transitions $X^1\Sigma_g^+ \rightarrow A^3\Sigma_u^+$, $X^1\Sigma_g^+ \rightarrow B^3\Pi_g$, and $X^1\Sigma_g^+ \rightarrow C^3\Pi_u$. These electron excitations are responsible for the first and second positive groups and Lyman–Birge–Hopfield bands, which are the most prominent of the atmospheric N_2 emissions. The electric dipole transition $X^1\Sigma_g^+ \rightarrow b^1\Pi_u$, which is one of the strongest features of the 50 eV electron energy loss spectrum, is shown to be extremely weak at an incident energy of 15 eV. The results suggest that the observed intensities of atmospheric N_2 emissions in the aurora are entirely compatible with low energy electron-impact excitation mechanisms. (auth) (UK)

48819 MID-LATITUDE RADIO-SATELLITE SCINTILLATION: THE VARIATION WITH LATITUDE. Preddey, G. F. Planet. Space Sci., 17: 1557-61(Aug. 1969).

The latitude variation of radio-satellite scintillation, and hence of small-scale ionospheric irregularities, is described. Records are available for a chain of southern-hemisphere stations, and also for a shipboard station. Analysis shows a weak maximum in irregularity near 35°S invariant latitude, minimum irregularity near 45°S and a strong increase toward higher latitudes. (auth) (UK)

48820 PROBE IMPEDANCE LOSS IN THE COLD MAGNETOPLASMA. Miyazaki, Shigeru (Radio Research Labs., Tokyo). Rep. Ionosphere Space Res. Jap., 23: Nos. 1-2, 75-8 (1969).

An interpretation is given of the loss of probe impedance in the cold plasma in a magnetic field by a consideration of the potential distribution of point charge by the quasi-static approximation. (M.O.W.)

48821 CATALOG OF DISTURBANCES IN IONOSPHERE, GEOMAGNETIC FIELD, FIELD INTENSITY OF RADIO WAVE, COSMIC RAY, SOLAR PHENOMENA, AND OTHER RELATED PHENOMENA, No. 53 (MAY 21–31, 1967). Rep. Ionosphere Space Res. Jap., 23: Nos. 1-2, 81-134(1969).

Tables of data are presented for the period May 21 through 31, 1967. (M.O.W.)

48822 VIBRATIONAL POPULATIONS OF $O_2(A^3\Sigma_u^+)$ AND SYNTHETIC SPECTRA OF THE HERZBERG BANDS IN THE NIGHT AIRGLOW. Degen, Vladimir (Univ. of Colorado, Boulder). J. Geophys. Res., 74: 5145-54(Oct. 1, 1969).

The relative vibrational populations of the O_2 $(A^3\Sigma_u^+)$ state in the nightglow have been determined for $0 < v' \leq 10$ by matching synthetic spectra of the Herzberg bands $(A^3\Sigma_u^+ - X^3\Sigma_g^-)$ to various published spectrograms. The synthetic spectra of the "pure" Herzberg bands obtained from this procedure are given at resolutions ranging from 1 to 25 A. (auth)

48823 GEOMAGNETIC PLASMA PROBE FOR SOLAR WIND. Sarabhai, V.; Nair, K. N. (Physical Research Lab., Ahmedabad, India). Proc. Indian Acad. Sci., Section A, 69: 291-306(June 1969).

Magnetograms from Alibag reveal that the range ΔH of the daily variation of the horizontal component is negatively correlated with the minimum value ΔH_{min} during a day. This relationship is largely unaffected by the degree of geomagnetic disturbance and holds good during all phases of the 11-year cycle of solar activity. From the nature of the relationship between ΔH and ΔH_{min}, it is concluded that the daily variation of the geomagnetic field at a low-latitude station outside the influence of the equatorial electrojet must be regarded as largely due to a weakening of the ambient field on the night side rather than an enhancement of the field on the day side due to ionospheric currents. There exists a good correlation between $(\Delta H)^2$ and the kinetic energy density of the solar wind in interplanetary space measured by IMP-1 satellite. It is suggested that ΔH is largely the result of the partial ring currents related to the convective drift of the plasma from the tail of the magnetosphere. Moreover, using the relationships established during the IMP-1 period, the annual mean kinetic energy density of solar wind for geomagnetically quiet days for the past 11-year cycle is estimated, treating the Earth as a plasma probe. (auth)

48824 ROCKET MEASUREMENTS OF H BETA PRODUCTION IN A HYDROGEN AURORA. Miller, J. R.; Shepherd, G. G. (Univ. of Saskatchewan, Saskatoon). J. Geophys. Res., 74: 4987-97(Oct. 1, 1969).

The results of a rocket flight into a quiet evening hydrogen at Fort Churchill, Canada, are described and their analysis presented. The $H\beta$ vertical emission rate profile, obtained with a two-channel photometer, is combined with proton measurements above 30 keV to obtain the proton energy spectrum below 30 keV. A result that is consistent with the accepted Doppler $H\beta$ profile can be obtained only by a significant alteration in the cross-sectional curve for $H\beta$ production by energetic protons. The derived energy spectrum cuts off sharply below about 25 keV and may have an additional low-energy component with an energy of a few keV. (auth)

48825 SHORT-PERIOD AURORAL PULSATIONS IN λ6300 O I. Eather, R. H. (Rice Univ., Houston, Tex. Lockheed Palo Alto Research Lab., Calif.). J. Geophys. Res., 74: 4998-5004(Oct. 1, 1969).

λ6300 O I pulsations with quasi periods of 2 to ~20 seconds were observed in pulsating auroras. The percentage modulation was only 0.03 to 0.9%, compared with modulations of up to 60% in λ5577 O I and λ4278 N_2^+. It is shown that rapid quenching of the O^1D level allows a small part of the level population to follow the excitation function. The required quenching rates are derived, and these show that the shorter period pulsations occur lower in the atmosphere and so are associated with more energetic electrons. Pulsation heights can be deduced only if the quenching coefficients are known. (auth)

48826 PARTICLE SUBSTORMS OBSERVED AT THE GEOSTATIONARY ORBIT. Arnoldy, R. L.; Chan, K. W. (Univ. of New Hampshire, Durham). J. Geophys. Res., 74: 5019-28 (Oct. 1, 1969).

A correlation study of the sudden intensity increases seen in the 50- to 150-keV and 150- to 500-keV energy channels of the ATS 1 electron spectrometer with the occurrence of magnetic substorms recorded at midnight has been made. As a result of this study, the following conclusions applicable for times of moderate magnetic activity are arrived at: (1) Electrons are produced in the 50- to 150-keV energy range as observed at 6.6 R_E during a magnetic substorm. The spectrum is soft since electrons are not always observable in the second energy window. (2) The electrons are produced at or near the midnight meridian and then drift on closed field lines around the earth. (3) The electron bunch produced as a result of the substorm in 75% of the 60 events studied is associated with precipitation observed by riometers as it drifts. An apparent dependence of precipitation on the level of substorm activity as given by the AE index suggests that the electrons are often produced of sufficient intensity to exceed a stable upper limit for trapped electrons at 6.6 R_E. (4) The frequency of occurrence of such particle substorms indicates that they might represent a quasi-steady source of electrons for the trapped radiation. (auth)

48827 NONLINEAR INTERACTION BETWEEN WHISTLERS. Harker, K. J.; Crawford, F. W. (Stanford Univ., Calif.). J. Geophys. Res., 74: 5029-40(Oct. 1, 1969).

An analysis is presented of nonlinear interaction in a cold homogeneous magnetoplasma, leading to wave growth in the whistler mode. For such amplification to occur, three waves must generally be involved whose frequencies and wave numbers satisfy certain synchronism relations. One of these is the energy source and is termed the "pump" wave. It is first established that the synchronism relations can be satisfied for two situations; either for the pump and one other wave in the upper branch of the whistler dispersion relation, and the third wave in the whistler branch, or for all three waves in the whistler branch. A nonlinear theory of the interaction is then described that yields an algebraic expression for the whistler growth rate. The mechanism described is effectively that of traveling-wave parametric amplification, and the theory demonstrates that for interaction to occur the waves must not all propagate exactly parallel to the static magnetic field. Extensive numerical computations have been carried out for the synchronism conditions and the growth rates over a wide range of magnetoplasma parameters. These indicate that the growth rates are likely to be too weak to be observable over most ranges of magnetospheric and ionospheric parameters. There are, however, situations in which gain might be observable, particularly if a strong pump wave were produced by a transmitter or plasma instability. A discussion is given of the possible relevance of parametric amplification to whistler amplification and triggered vlf emissions. It is concluded that there are some common features that might repay further study. Extension of the nonlinear theory would be required, to active plasma situations, in which energetic charged particles provide the source of energy analogous to the pump wave in the present theory. (auth)

48828 ATMOSPHERIC DENSITY ABOVE 158 KILOMETERS INFERRED FROM MAGNETRON AND DRAG DATA FROM THE SATELLITE OV1-15 (1968-059A). Carter, Virginia L.; Ching, Barbara K.; Elliott, David D. (Aerospace Corp., El Segundo, Calif.). J. Geophys. Res., 74: 5083-91(Oct. 1, 1969).

A cold-cathode magnetron pressure gage and a C-band radar beacon were part of the complement of experiments aboard the polar-orbiting atmospheric research satellite OVI-15 (1968-059A). Over the period July 13–15, 1968, when the perigee of the satellite was near the equator at about local noon, the atmospheric density–height profiles were repeatedly measured down to 158 km. The profiles agreed in the northern and southern hemispheres below 200 km, but above 200 km the northern profile was greater than the southern, in approximate agreement with the Jacchia model that includes a symmetric density bulge at the subsolar latitude at 1400-hr local time. During a moderate magnetic disturbance the atmospheric density at latitudes below about 40° increased with an amplitude and lag that are adequately described by the Jacchia model. The duration of the density enhancement was observed to be several hours longer than the duration of the geomagnetic disturbance. At latitudes above 40° (which were available to us only in the southern hemisphere) the density enhancement decreased markedly with increasing latitude. The drag-determined density near perigee was the same, within the estimated errors, as that determined from the gage measurement, in contrast to the factor-of-2 discrepancy found in a similar comparison of data from the satellite Explorer 17. (auth)

48829 ELECTRIC AND MAGNETIC FIELD MEASUREMENTS NEAR AN AURORAL ELECTROJET. Potter, W. E.; Cahill, L. J. Jr. (Univ. of New Hampshire, Durham). J. Geophys. Res., 74: 5159-60(Oct. 1, 1969).

The results are presented from sounding rocket experiments to investigate the relations between visible aurorae, low-energy charged particles, electric fields, and ionospheric currents. Launch azimuth was 76°E, geographic, and the elevation was 85°. The data are discussed. (M.O.W.)

48830 PROTON CYCLOTRON ECHOES IN THE TOPSIDE IONOSPHERE. Matuura, Nobuo; Nishizaki, Ryo (Radio Research Labs., Tokyo). J. Geophys. Res., 74: 5169-72(Oct. 1, 1969).

The satellite positions where such echoes were observed are plotted along the satellite passes. The data were chosen from those received at the Kashima station during 1967. The continuous thick curves along the passes show the locations where the echoes were observed on three or more sequential ionograms, and the dotted points on the passes show the positions of the discrete ionograms on which the echoes were observed. It is seen that the echoes were observed more frequently near the geomagnetic equatorial region than the high-latitude region. (M.O.W.)

48831 ON THE DYNAMIC RESPONSE OF THE THERMOSPHERE AT LOW ALTITUDES TO GEOMAGNETIC DISTURBANCES. Lew, Stephen K. (Lockheed Missiles and Space Co., Sunnyvale, Calif.). J. Geophys. Res., 74: 5093-8(Oct. 1, 1969).

The 0.23-day (5.5 hours) time lag reported by Jacobs for the response time of the atmosphere to geomagnetic disturbances in the 165- to 200-km altitude region has been found to give rise to an incorrect interpretation for the time constant of the atmosphere at those altitudes. By re-examining Jacobs' data and extending his analysis, actual time delays of 0.48-day by which the atmospheric response physically lags the peak of the geomagnetic disturbances are demonstrated. It is also shown that this time lag is dependent upon the intensity of the geomagnetic perturbation, which for unusually large storms, may be as short as 0.10-day. (auth)

48832 LATITUDINAL OBSERVATIONS OF THE THERMAL BALANCE IN THE NIGHTTIME PROTONOSPHERE. Mahajan, K. K.; Brace, L. H. (Goddard Space Flight Center, Greenbelt, Md.). J. Geophys. Res., 74: 5099-5112(Oct. 1, 1969).

Alouette-2 electrostatic probe measurements of the nighttime electron temperature (T_e) and concentration (N_e) in the height range 2500 ± 500 km are presented on global basis (−60 to +60 geomagnetic latitude). The major feature of the protonosphere at this altitude is a broad minimum in T_e at the low latitudes with values around 1800°K. The electron temperature increases sharply to over 3000°K at the middle latitudes. The electron concentration exhibits a pair of maxima at about 30° north and south with values ranging from $4 \times 10^3/cm^3$ in fall to $8 \times 10^3/cm^3$ in local summer. No definitive seasonal dependence is apparent in T_e. Comparison of the present Alouette 2 measurements with nearly simultaneous measurements on Explorer 22 during summer 1966 reveal positive temperature gradient of T_e along field lines. Typical gradients at 1000 km are 0.6°/km on the 35° field line and 1.2°/km on the 50° field line. These gradients are consistent with the thermal energy stored in the nocturnal protonosphere, and therefore no external source of heat is required to explain the observations. (auth)

48833 NONLINEAR STABILIZATION OF A TWO-STREAM PLASMA INSTABILITY IN THE IONOSPHERE. Skadron, G.; Weinstock, Jerome (Environmental Science Services Administration, Boulder, Colo.). J. Geophys. Res., 74: 5113-26(Oct. 1, 1969).

The theory of the two-stream plasma instability arising in the equatorial electrojet is extended to the nonlinear domain by means of a nonlinear treatment of the ion kinetic equation. The solution for the ion distribution function is expressed in terms of a "perturbed orbit function," which is the solution for an average of the ion motion through the turbulent field of the plasma. The inclusion of the effects of turbulence on the ion orbit is found to introduce a

damping term into the dispersion relation, which causes the growth rates of the linearly unstable waves to decrease to zero as the turbulence grows. The stabilization time needed for the electric field spectrum to achieve its asymptotic value is estimated. For an electrojet velocity of 500 m/sec it is found that the stabilization time is approximately 0.5 second and the energy density in macroscopic waves reaches 3×10^{-12} erg/cm^3. Finally the asymptotic electric field spectrum resulting in the electrojet is estimated, assuming all modes grow in amplitude according to their linear growth rates for a time equal to the stabilization time. (auth)

48834 CLASSIFICATION OF POLAR MAGNETIC DISTURBANCES. Rostoker, Gordon (Univ. of Alberta, Edmonton). J. Geophys. Res., 74: 5161-8(Oct. 1, 1969).

The importance of not considering geomagnetic bays and polar magnetic substorms to be one and the same is discussed. It is shown that there are a minimum of two categories of bay-type disturbances, each of which has different characteristics. (M.O.W.)

48835 INITIAL OBSERVATIONS OF GEOMAGNETICALLY TRAPPED PROTONS AND ALPHA PARTICLES WITH OGO 4. Fritz, T. A.; Krimigis, S. M. (Univ. of Iowa, Iowa City). J. Geophys. Res., 74: 5132-8(Oct. 1, 1969).

Two totally depleted solid-state detectors with thicknesses of 34 and 7.2 microns designed to measure protons and alpha particles, respectively, were launched into a near-polar orbit on the OGO 4 spacecraft. Both detectors have four electronically determined energy channels. Initial results, based on data obtained on August 8 and 27, 1967, show the following: (1) the j_α/j_p ratio is $\sim 7 \times 10^{-4}$ and 2×10^{-4} for particles of $E \gtrsim 0.35$ and 0.46 MeV/nucleon, respectively; (2) the observed ratio ranges from 2×10^{-4} for $E \gtrsim 0.46$ MeV/nucleon, to 2.4×10^{-3} for $E \geq 0.68$ MeV/charge, to 1.9×10^{-2} for $E_{total} \geq 1.06$ MeV when the proton and alpha particle intensities are compared on the basis of equal energy/nucleon, equal energy/charge, and equal total energy, respectively; (3) there are indications that the ratio j_α/j_p decreases as the energy/nucleon increases. Comparison of the data with various predictions of models that consider the solar wind as source of trapped particles shows serious discrepancies between theory and observations. (auth)

48836 INTENSITY CORRELATIONS AND SUBSTORM ELECTRON DRIFT EFFECTS IN THE OUTER RADIATION BELT MEASURED WITH THE OGO 3 AND ATS 1 SATELLITES. Pfitzer, K. A.; Winckler, J. R. (Univ. of Minnesota, Minneapolis). J. Geophys. Res., 74: 5005-18(Oct. 1, 1969).

During late December 1966 and January 1967 the elliptically orbiting satellite OGO 3 entered the magnetosphere within 30° of the subsolar point and within 10° of the geomagnetic equator. This permits the measurement of r_b, the distance to the magnetosphere boundary, which is a necessary parameter for the Mead model magnetic field calculations. The electron fluxes measured by an electron spectrometer and an ion chamber of OGO 3 are correlated with electron fluxes on the geostationary satellite ATS 1 at the exact time when both satellites are on the same drift shells as calculated from the Mead model magnetic field with separations in local time up to 180°. During quiet times an absolute comparison of the fluxes from 50 to 1000 keV gives a linear relationship indicating agreement of the measurements over a three order-of-magnitude range of intensities. During substorm increases, the ATS 1 and OGO 3 measurements have similar profiles but are delayed in time with respect to each other. The observed delays are smaller for higher energy electrons and larger for greater separations in local time. As an example, the measured delays for 50, 150, and 400 keV electrons on January 11, 1967, when the local-time separation was 110° are 26, 13 to 17, and 5 minutes, respectively. The observed delays are consistent with newly created electrons being produced in a region near local midnight. These newly produced electrons then gradient drift past the two satellites. The production region is shown to be 30 to 60° in width and about 4 R_E in depth. (auth)

48837 SOURCE OF HIGH-ENERGY PROTONS TRAPPED ON LOW L SHELLS . Imhof, W. L.; Reagan, J. B. (Lockheed Palo Alto Research Lab., Calif.). J. Geophys. Res., 74: 5054-64(Oct. 1, 1969).

The intensities of high-energy (>64 MeV) protons trapped on very low L (≤1.20) shells were measured on three satellite flights with similar instruments possessing a large geometric factor and a good separation of protons from electrons and other backgrounds. The data have been analyzed with the expectation that the extreme lower edge of the inner radiation belt a more complete separation of the various possible source mechanisms might be feasible. The shapes of the spatial flux profiles are found to be in reasonable agreement with the predictions of an injection rate nearly independent of position and a loss rate due to atmospheric interactions. This result suggests that in this region the effects of pitch-angle and/or L-shell diffusion are small, thereby providing a direct measurement of the injection rate by other means, in particular the cosmic-ray albedo-neutron decay source. However, the magnitudes of the measured fluxes are found to be higher by about a factor of 20 than those expected for the latter source and are consistent with the findings of other investigators, also for low-altitude protons but at considerably higher L shells. These discrepancies might be attributed to uncertainties in the many quantities involved, including the cosmic-ray albedo-neutron decay source strength. Alternatively, a significant contribution may arise from other source mechanism(s), such as the influx of protons trapped on higher L shells, with special properties resulting in flux profiles at low L shells consistent with an injection rate nearly independent of position coupled with atmospheric losses. (auth)

48838 INTERACTION OF THE SOLAR WIND WITH PLANETARY ATMOSPHERES. Elco, Richard A. (Carnegie-Mellon Univ., Pittsburgh). J. Geophys. Res., 74: 5073-82(Oct. 1, 1969).

Neither Venus nor the moon have a significant dipole magnetic field, and their atmospheres are exposed to the solar wind and the interplanetary magnetic field. As the solar wind ions penetrate the atmosphere, photo- and charge-exchange ionization reactions alter the density and velocity of the ion stream. A collisionless reacting hydromagnetic model is used to describe the flow of atmospheric and solar wind ions normal to the interplanetary magnetic field. Because of the ionization reactions, the mass flow increases along the ion stream lines, and the usual adiabatic invariant, $P_\perp/nB$, is not constant. The supersonic solutions obtained show that E/B decreases with penetration of the solar wind into an atmosphere. A critical penetration optical depth, τ_s, at which a hydromagnetic shock forms, is determined as a function of the ion generation rate in the ionosphere and the ratio of the photon flux to the solar wind flux. Recombination is taken into account and used to establish a minimum optical depth at which a hydromagnetic shock can be maintained in an isothermal atmosphere. In the case of Venus (CO_2 atmosphere), the hydromagnetic shock forms for $10^{-9} < \tau_s < 2 \times 10^{-4}$, i.e., above the usual Chapman layer. The exact value of τ_s is strongly dependent on the value of the scale height which is used. For the moon, the lunar atmospheric optical depth is less than that required for the formation of a hydromagnetic shock. (auth)

Low-Temperature Physics

Refer also to abstracts 48489, 48519, 48996, 49261, and 49262.

48839 TUNNELING AT POINT CONTACTS BETWEEN SUPERCONDUCTORS. Barnes, L. J. (Atomics International, Canoga Park, Calif.). Contract AT(04-3)-701. Phys. Rev., 184: 434-46(Aug. 10, 1969).

An investigation was conducted on the tunneling behavior which can occur at anodized point contacts between various superconducting metals and alloys (Nb, Ta, Nb–Ta, and Ti–Mo). A large excess background current almost always exists, but the usual tunneling characteristics are observed. The values of the superconducting energy gaps Δ determined from this work agree well with those determined from observations of tunneling between thin films. In the case of contacts between like metals, a subharmonic sequence of features located at $V = 2\Delta/n$ (n an integer) is generally observed. For unlike metals structure is observed at $\Delta_1 + \Delta_2$, Δ_1, and Δ_2/n ($\Delta_2 < \Delta_1$). When $\Delta_2 < \frac{1}{3}(\Delta_1 + \Delta_2)$, no structure is discernible at $(\Delta_1 + \Delta_2)/(2n + 1)$. These results agree with recent thin-film tunneling work of Rowell and Feldman. The various subharmonic features appear to be peaks in the dc current-voltage characteristics of the junctions. The behavior of the junctions in a magnetic field was always characteristic of superconducting weak links probably formed by metallic shorts. Available evidence points to absorption of weak-link radiation within the junctions as the probable cause of the subharmonic features, but the nature of the physical mechanisms involved remains unclear. (auth)

48840 TEMPERATURE AND MAGNETIC FIELD DEPENDENCE OF THE SUBHARMONIC STRUCTURE IN Pb–Pb SUPERCONDUCTING TUNNELING. Bright, A. A.; Merrill, J. R. (Dartmouth Coll, Hanover, N. H.). Phys. Rev., 184: 446-50(Aug. 10, 1969).

Peaks occur in the I-V characteristics of lead/lead oxide/lead superconducting tunnel junctions at submultiples $2\Delta/n$ of the full energy gap 2Δ. This "subharmonic structure" has been studied in detail for its dependence on temperature and magnetic field. Its position varies with temperature identically as the energy gap does. The widths of the subharmonic peaks are independent of temperature. Magnetic fields are found to reduce the amplitudes and increase the widths of the structure. Evidence is presented that none of the present theories explains the phenomenon satisfactorily. (auth)

48841 ROTATING SUPERCONDUCTORS. Brickman, Norman F. (Yale Univ., New Haven). Phys. Rev., 184: 460-5 (Aug. 10, 1969).

Measurements are presented on the magnetic field generated within a superconductor when it is set into rotation—the so-called London moment. Solid rods and hollow cylinders were investigated in a variety of materials in both single-crystal and polycrystalline specimens, and in both elemental and alloy superconductors. In the case of the hollow cylinders, wall thicknesses as thin as 27 Å have been employed. In all cases the results are in excellent agreement with the London formula. (auth)

48842 SIZE EFFECTS AND ENHANCED TRANSITION TEMPERATURES IN SUPERCONDUCTORS. Rothwarf, A. (Radio Corporation of America Labs., Princeton, N. J.). Phys. Lett., 30A: 55-6(Sept. 8, 1969).

For small particles or films, the existence of a low-frequency phonon cutoff leads to a reduction in the pair-breaking rate and to enhanced transition temperatures. (auth)

48843 RELAXATION OF A THICK SUPERFLUID HELIUM FILM TOWARDS EQUILIBRIUM. Armitage, J. G. M. (Univ. of St. Andrews, Scotland). Phys. Lett., 30A: 29-30(Sept. 8, 1969).

The draining reservoir model, proposed by Tilley and Kuper to explain the enhanced superfluid helium transfer rates, is shown to be untenable if thermal relaxation is taken into account. Experimental evidence with a very thin-walled beaker also fails to support the model. (auth)

48844 INFLUENCE OF A TRANSPORT CURRENT ON THE INTERMEDIATE STATE OF SUPERCONDUCTIVE LEAD. Sarma, N. V.; Wilcockson, A. (International Research and Development Co. Ltd., Newcastle upon Tyne, Eng.). Phil. Mag., 20: 539-46 (Sept. 1969).

The influence of a radial transport current on the flux distribution in superconductive lead discs situated in a magnetic field parallel to their axes was investigated by a Bitter pattern technique at 4.2°K. The results showed that at low magnetic fields and low transport current densities the intermediate-state patterns were aligned into concentric circles around the specimen axis. Increasing the magnetic field or transport current density was found to cause movement of these concentric patterns. (auth) (UK)

48845 TYPE-II SUPERCONDUCTIVITY. Saint-James, D. (CEN, Saclay, France); Sarma, G.; Thomas, E. J. Oxford, Pergamon Press, 1969. 304p. 105s.

The subject is discussed under the following main headings: reversible properties (introductory; the phenomenological theory of Ginzburg and Landau; magnetic properties of type-II superconductors; surface superconductivity; microscopic theory; miscellaneous properties of type-II superconductors in high fields—the paramagnetic effect—gapless superconductivity; and thermal properties); irreversible properties (flux trapping and the irreversible magnetization characteristic; flux movement within type-II superconductors; critical current characteristics; and applications). (UK)

48846 PHASE TRANSITION ANOMALY AT H_{c2} IN LOW-κ TYPE-II LEAD–INDIUM SUPERCONDUCTING ALLOYS. Ehrat, R.; Rinderer, L. (Univ., Lausanne, Switzerland). Phys. Lett., 29A: 712-13(Aug. 25, 1969).

A first-order mixed–normal-state phase transition is observed in low-κ type-II lead–2% indium alloys. (auth)

48847 COUNTERFLOW OF LIQUID HELIUM II IN A ROTATING CHANNEL. Le Ray, M.; Bataille, J.; Francois, M. (Laboratoire de Mechanique des Fluides, Orsay, France). Phys. Lett., 29A: 699-700(Aug. 25, 1969).

It was shown experimentally that the interaction between counterflow and rotation is almost additive at low temperature but, at higher temperature, the effect of rotation annihilates the effect of counterflow. (auth)

48848 UNIQUE SET OF CRITICAL EXPONENTS AND ORDER-PARAMETER THEORIES FOR 1-, 2-, 3-DIMENSIONAL SUPERFLUIDS. Wong, V. K. (Univ. of Michigan, Ann Arbor). Phys. Lett., 30A: 38-9(Sept. 8, 1969).

A unique set of critical exponents [$\alpha = \alpha' = 0$: $\beta = \frac{1}{2}$. $\gamma = \gamma' = 1$: $\delta = 3$: $\nu = \nu' = 2/d$: $\eta = \frac{1}{2}(4-d)$] is determined theoretically and used to determine order-parameter theories for d = 1-, 2-, 3-dimensional Bose and Fermi superfluids. (auth)

48849 ENERGY GAP, TRANSITION TEMPERATURE, AND ELECTRON–ELECTRON INTERACTION OF THE WEAK-COUPLING SUPERCONDUCTORS TIN AND INDIUM AS A FUNCTION OF THE MEAN FREE PATH OF THE ELECTRONS. Bergmann, G. (Univ., Goettingen, Ger.). Z. Phys., 228: 25-40(1969).

The energy gap and the transition temperature of the weak coupling superconductors tin and indium increase with decreasing mean free path of the electrons. The ratio $\alpha = 2\Delta_0/kT_c$ increases proportionally to the reciprocal mean free path from 3.6 to 4.0 for tin and from 3.6 to 3.95 for indium. A theoretical consideration is presented showing that the electron-electron interaction is increased in dirty superconductors. Without any fit it is found from the theoretical calculation an increase in NV for indium of $\delta NV = 5 \times 10^{-10}\ m/l_{tr}$ and for tin $\delta NV = 2 \times 10^{-10}\ m/l_{tr}$ (l_{tr} is the transport mean free path of the electrons). The experiments give an increase in NV for indium of $\delta NV = 4.2 \times 10^{-10}\ m/l_{tr}$ and for tin $\delta NV = 1.7 \times 10^{-10}\ m/l_{tr}$. (auth)

48850 THEORY OF A CYLINDRICAL JOSEPHSON JUNCTION. Cheishvili, O. D. (Inst. of Physics, Tbilisi, USSR). Sov. Phys.-Solid State (Engl. Transl.), 11: 138-9(July 1969).

Translated from Fiz. Tverd. Tela, 11: 185-6(Jan. 1969).

An investigation was made of the penetration of a magnetic field and the dependence of the current on applied voltage in cylindrical Josephson junctions, which are simultaneously finite and closed. Equations are derived which show that the current is inversely proportional to the number of vortices in the barrier if damping occurs chiefly on the normal current, and to the square of the number of vortices if field absorption is the basic damping mechanism. (D.L.C.)

48851 INFLUENCE OF MECHANICAL SURFACE TREATMENT ON THE HYSTERETIC BEHAVIOUR OF TYPE-II SUPERCONDUCTORS IN THE MIXED STATE. Kwasnitza, K.; Winkler, W. (Univ., Erlangen, Ger.). Z. Phys., 227: 391-8(1969).

It is experimentally shown, that mechanical roughening of the surface of Nb cylinders leads to a hysteretic behavior of magnetization in an applied magnetic field. Hysteresis is caused both by trapping of flux vortices near the surface and by induced persistent surface currents. (auth)

48852 SUPERCONDUCTING TUNNELING EFFECTS IN THE MIXED STATE OF Nb. Tsuda, Nobuo (Tokyo Univ.). J. Phys. Soc. Jap., 27: 856-61(Oct. 1969).

Superconducting tunneling effects in the mixed states of Nb, whose $H_{c2}(0) = 4450$ Oe, were observed using the usual oxidation techniques. Results are rather well explained by the theory of Brandt et al., with the assumption of diffuse boundary scattering, if $\Delta \cdot \Lambda/\hbar \cdot v_f$ is replaced by $\Delta \cdot \Lambda/\hbar \cdot v_f \cdot \alpha$, where α is an arbitrary parameter. (auth)

48853 TUNNELING EFFECTS IN DIRTY SUPERCONDUCTORS: SEMICONDUCTOR JUNCTIONS. Tsuda, Nobuo (Tokyo Univ.). J. Phys. Soc. Jap., 27: 874-9(Oct. 1969).

Superconducting tunneling effects were observed for $Pb_{0.7}In_{0.3}$–GaAs junctions in the magnetic field which was varied from zero to upper critical fields. Results are explained well with de Gennes' theory above $0.7H_{c2}$ and 0.56_{c3}, if we take τ, the correlation time, as a parameter. Gap parameters are also explained well with usual theories of type-II superconductivity. (auth)

48854 MAGNETIC BEHAVIOR OF PURE TANTALUM AND SOME TANTALUM–NIOBIUM ALLOYS IN THE SUPERCONDUCTING STATE. Smith, Charles William Jr. Athens, Ohio, Ohio Univ., 1968. 119p.

Thesis.

Isothermal magnetization measurements were made on pure tantalum and four tantalum–niobium alloys with the following compositions, Ta_xNb_{1-x} where x = 0.95, 0.85, 0.65, and 0.50. Approximately fifteen to twenty magnetization curves were made, using a continuous curve integrating magnetometer, at different temperatures between 1.00°K and the critical temperature for each sample. The magnetometer output for each temperature was an x–y recorder plot of $-4\pi M$ versus the applied magnetic field, H. Each curve was analyzed to find the bulk thermodynamic critical field, H_c; the lower critical field, H_{c1}; the upper critical field, H_{c2}; and the slope of the magnetization at the upper critical field. The critical temperature, T_c was measured for each sample using a field-sweep method, and the resistivity of each sample was measured at room temperature and just above the critical temperature. This work shows that isothermal magnetization measurements are a powerful means of determining the detailed behavior of superconductors. From these measurements, almost all of the fundamental magnetic, calorimetric and electronic parameters that characterize the superconducting state may be calculated. The results presented show that the temperature and electronic mean-free-path dependence of the magnetic properties of type-II superconductors are, without exception, in qualitative and, in many cases, quantitative agreement with the generalization of the Ginzburg–Landau theory, according to Gorkov, Maki, Halfand, and Werthamer and Eilenberger. It is important to note, however, that the quantitative discrepancies are difficult to analyze since one is never sure whether the sources of disagreement are the approxi-

mations necessary for mathematical closure in the local theories or the results of the difficulties which arise in including nonlocal electrodynamics. The fundamental features of this study are summarized. (TSS) (Disser. Abstr.)

48855 CONTRADICTION BETWEEN QUANTUM HYDRODYNAMICS AND THE EXISTENCE OF PARTICLES. Froehlich, H. (Univ. of Liverpool). Physica, 34: 47-8(1967).

The formalism for the quantization of the Euler equations has been known for some time. Calculation of the roton energy led, however, to infinities requiring introduction of a cutoff. One might have expected the derivation of an energy gap to be connected with the existence of particles in the fluid. Hence, one might conjecture that present-day quantum hydrodynamics is in contradiction with the existence of particles. This is, in fact, the case as is shown. (M.H.R.)

48856 ON THE COEXISTENCE OF SINGLE- AND TWO-PARTICLE CONDENSATION IN AN INTERACTING BOSON GAS. Coniglio, A.; Mancini, F.; Maturi, M. (Univ., Naples. CNR, Naples). Nuovo Cim., 63B: 227-35(Sept. 11, 1969).

The aim of this article is to study the single- and two-particle condensations in an interacting boson system at T = 0. A model is developed which makes it possible to pass through a first-order phase transition from one type of condensation to the other; at the critical point coexistence of both states is noted. This type of model can give insight into some effects which have been observed in helium and which may depend on the presence of both types of condensation. (auth)

48857 QUASI-THERMODYNAMIC THEORY OF ^{3}He AND ^{4}He SOLUTIONS. Nanda, V. S.; Chandra, R. (Univ. of Delhi). J. Low Temp. Phys., 1: 275-88(Aug. 1969).

The conventional theory of nonideal solutions is modified on the basis of Gorter's hypothesis, and various properties of ^{3}He and ^{4}He solutions are investigated. The variation of λ temperature with ^{3}He concentration is explained adequately right up to the phase separation region. A comparison between the theoretical and experimental results for excess chemical potentials, excess entropy, and excess enthalpy is then carried out. In view of the recognized complex behavior of the solution in the region 1 to 2°K, the observed satisfactory agreement between theory and experiment may be regarded as a strong support for the assumptions made in this work. (auth)

48858 TRAPPED-ION MOTION IN HELIUM II. Glaberson, William I. (Univ. of Oregon, Eugene). J. Low Temp. Phys., 1: 289-311(Aug. 1969).

The results of a series of experiments on the mobility of negative ions trapped on quantized vortex lines in superfluid helium are presented. Trapped-ion mobilities were measured as a function of temperature, pressure, and ^{3}He concentration. Some of the experimental data have been previously reported. The temperature and pressure dependence of trapped-ion mobilities is qualitatively different than that of free ions. The ^{3}He data strongly suggest that the negative ion bubble does not become deformed on the vortex line. A model is presented for a vortex line having a central "core" of normal fluid extending over a distance of several angstroms surrounded by a "tail," a region of excess roton density whose momenta are predominantly aligned opposite to the direction of circulation of the superfluid. This model is used to calculate the drag on a negative ion trapped on a vortex line. The model appears to account for the experimental results satisfactorily. (auth)

48859 ELECTROMAGNETIC ATTENUATION OF SHEAR WAVES IN SUPERCONDUCTORS. Fossheim, K.; Torvatn, B. (Univ. of Oslo). J. Low Temp. Phys., 1: 341-54(Aug. 1969).

A detailed analysis of the electromagnetic attenuation in superconductors was carried out, with specific reference to type-I materials. The rapid rise at T_c predicted by Cullen and Ferrell is found to be most pronounced in superconductors with low acoustic velocities. Also, the effect occurs at lowest frequencies in these materials. It is demonstrated how the shape of the transition curve reflects anisotropies in electronic and elastic properties. Very close to T_c the attenuation at low frequencies is inversely proportional to the real conductivity function, while at high frequencies it is proportional to that conductivity. Numerical results for Al, In, Pb, and Sn are presented. Although these materials are similar with regard to electronic structure, they are characteristically different with regard to electrodynamic properties as probed by ultrasonic phonons. From the present analysis it is concluded that ultrasonic probing of the electrodynamics of superconductors offers a sensitive and, at the present, unique way of determining the response of a superconductor to a single variable wave number. In addition, the wave numbers available in this way are in a range where it has been most difficult to obtain such information by penetration depth studies, namely, in the transition region between pure local and nonlocal behavior. (auth)

48860 CRITICAL FIELDS AND GENERALIZED GINZBURG–LANDAU PARAMETERS FOR Mo–Re ALLOYS CONTAINING PARAMAGNETIC IMPURITIES. Hoenig, H. E.; Barth, N. (Univ., Frankfurt am Main). J. Low Temp. Phys., 1: 355-73(Aug. 1969).

The temperature dependence of the upper critical field H_{c2} and the thermodynamical field H_c for superconducting Mo–Re alloys containing magnetic impurities was investigated. In addition, the temperature dependence of the Ginzburg–Landau parameters $k_1(T)$ and $k_2(T)$ has been determined by measuring the magnetization and the specific heat. The findings are compared with the theory of Fulde and Maki. In agreement with theory, the measurements show that the two pair-breaking mechanisms involved (magnetic field and magnetic impurities) are nonadditive if one departs from the linearized Ginzburg–Landau equation. (auth)

48861 EXPERIMENTAL STUDIES ON FOURTH SOUND IN SUPERFLUID HELIUM. Hubert, J. M.; Larson, E. V.; Squire, C. F. (Texas A and M Univ., College Station). J. Low Temp. Phys., 1: 375-80(Aug. 1969).

In a superfluid liquid-helium cavity packed with a fine powder, only the supercomponent is free to move and pressure waves transmitted by the supercomponent are called "fourth sound." It was observed that the resonance frequency of the powder-filled chamber may be shifted by introducing vortices. Both static and dynamic measurements were made on the resonance frequency and signal height in order to explore the effect of exceeding the critical velocity of the superfluid in the powder-filled chamber. (auth)

48862 INTERACTION OF A MACROSCOPIC PROBE WITH LIQUID He II. Pollock, F. (Stevens Inst. of Tech., Hoboken, N. J.). J. Low Temp. Phys., 1: 381-3(Aug. 1969).

It is shown that the results of the Rayleigh disk experiment of Pellam are accounted for by the thermohydrodynamic equations when the relative velocity between the normal and superfluid components is included and the probe acts as an isothermal boundary. (auth)

48863 NEW MANIFESTATIONS OF THE JOSEPHSON EFFECT IN HELIUM. Schick, M.; Zilsel, P. R. (Case Western Reserve Univ., Cleveland). J. Low Temp. Phys., 1: 385-8(Aug. 1969).

Using a method due to Bloch, it is shown that in thermodynamic equilibrium an annular container of mean radius R, mass M, containing N atoms of helium II of mass m each will, when subjected to a torque τ, evince oscillations in its angular acceleration about the classical value. The frequency, ν, of these oscillations is given by $\hbar\nu/m = \tau/(M + Nm)$. The difficulty of achieving equilibrium is pointed out. (auth)

48864 SINGLE-PARTICLE CONDENSATE AND PAIR-CORRELATION THEORY OF INHOMOGENEOUS BOSON SYSTEMS. Kobe, Donald H. (Oersted Institutet, Copenhagen). J. Math. Phys. (N.Y.), 10: 1507-17(Aug. 1969).

A theory of inhomogeneous boson systems is developed which takes into account both the single-particle condensate and pair correlations. A set of three coupled nonlinear integrodifferential equations is derived for the condensate wavefunction and the two Bogolyubov quasi-particle wavefunctions. Half-integral h/m circulation can exist only when the single-particle condensate is completely depleted. General considerations of off-diagonal long-range order and circulation quantization also leads to this conclusion. (auth)

48865 ONE-DIMENSIONAL PHASE TRANSITION. Strecker, Joseph L. (Wichita State Univ., Kansas). J. Math. Phys. (N.Y.), 10: 1541-54(Aug. 1969).

The Berlin–Witten–Gersch model of a classical gas gives a phase transition in one dimension for a potential $V = g\gamma e^{-\gamma R}$, $R > \delta$, $= \infty$, $R < \delta$, in the limit $\gamma \to 0$. The correlation function is nonvanishing in the transition region; it vanishes outside. Investigation of the P–L isotherms (where L is the one-dimensional volume) shows a discontinuity in the first derivative at the transition points. (auth)

48866 COLLISIONLESS SOUNDS IN SUPERFLUID HELIUM. Enz, C. P. (Univ., Geneva). Nuovo Cim., Lett., 2: 323-6 (Sept. 1, 1969).

Since an explanation of a neutron scattering measurement of first sound was proposed in terms of "collisionless" or "zero" sound, the problem of low-temperature first sound in He II has received considerable attention, both from experiment and from theory, without bringing a full understanding of the problem. It is pointed

out that very little of the data that disagree with this explanationn is actually inside the collisionless domain, whereas the theory it is compared with is only valid in this domain. Suggestions for analyzing the data and for a more careful treatment of the phonon–phonon interactions are discussed. (M.H.R.)

48867 SUPERCONDUCTING MOTOR. Appleton, Anthony Derek. Ind. Res., 11: No. 9, 72-5(Sept. 1969).

The problems involved in cooling and designing a superconducting motor are summarized. The Fawley motor is described in some detail. The future applications of such motors are discussed. (M.H.R.)

48868 FLUCTUATION EFFECTS IN THE ac CONDUCTIVITY OF THIN LEAD FILMS ABOVE THE SUPERCONDUCTING TRANSITION TEMPERATURE. Lehoczky, S. L. (A.) (McDonnell Douglas Corp., St. Louis); Briscoe, C. V. Contract SD-100. Phys. Rev. Lett., 23: 695-7(Sept. 29, 1969).

The transmission of microwaves through thin (~100-Å) Pb films indicates considerable excess conductivity at temperatures above the superconducting transition temperature. Both the frequency and temperature dependences of this conductivity are in agreement with a calculation of Schmidt which takes account of the fluctuations of the order parameter for a film of thickness less than the Ginzburg–Landau coherence length. This agreement between experiment and theory supports Schmidt's choice of time-dependent Ginzburg–Landau equations. (auth)

48869 ANISOTROPY OF THE SURFACE IMPEDANCE IN THE SURFACE-SHEATH REGIME AS EVIDENCE FOR FLUCTUATIONS OF THE SUPERCONDUCTING ORDER PARAMETER. Maki, Kazumi (Tohoku Univ., Sendai); Fischer, Gaston. Phys. Rev., 184: 472-6(Aug. 10, 1969).

In the surface-sheath regime, the high-frequency surface impedance of a superconductor is a function of the angle between the polarization plane of the incident wave's electric vector E_ω and the steady magnetic field H. This anisotropy arises from collective fluctuations of the superconducting order parameter $\Delta(x)$. In the ground state, $\Delta(x)$ is a nodeless function. When E_ω and H are perpendicular, the incident electromagnetic wave can couple to the intrinsic sheath currents and excite $\Delta(x)$ into states with a finite damping coefficient. No such excitations are possible when E_ω and H are parallel. The extra absorption predicted by theory in the dirty limit explains experimental data obtained from two lead-based alloys very well. These experiments should, therefore, be considered as direct evidence for the existence of collective fluctuations of the order parameter in the surface-sheath regime of superconductors. (auth)

48870 SIMILARITY OF LONGITUDINAL AND TRANSVERSE CRITICAL CURRENTS IN SUPERCONDUCTING ALLOYS WITH RIGIDLY PINNED VORTEX LATTICE. Bychkov, Yu. F.; Vereshchagin, V. G.; Zuev, M. T.; Karasik; V. R.; Kurganov, G. B.; Mal'tsev, V. A. (Lebedev Inst. of Physics). JETP Lett. (USSR) (Engl. Transl.), 9: 404-7(June 20, 1969).

Translated from Zh. Eksp. Teor. Fiz., Pisma Redaktsiyu, 9: 652-7(June 20, 1969).

Critical currents were investigated in alloys of niobium with titanium and zirconium, containing isotropically distributed inclusions of the ω or α phase. The measurements of the longitudinal and transverse critical currents were made on the same samples. The composition and characteristics of the samples are tabulated. A comparison of the results shows that the similarity of the critical currents appears not only in their dependence on the magnetic field intensity, but also in the temperature dependence. (M.H.R.)

48871 SUPERCONDUCTIVITY AT HIGH PRESSURES. Brandt, N. B.; Ginzburg, N. I. (Moscow State Univ.). Contemp. Phys., 10: 355-84(July 1969).

Recent results of studies of superconductivity at high pressures are discussed. In the last few years there has been significant progress in developing new methods for obtaining pressures up to 300 kbar and the temperature range of experiments has been extended down to 0.1°K. Superconducting modifications of silicon, germanium, antimony, tellurium, selenium, phosphorus and cerium have been discovered as a result of the increase in attainable pressures, and these have been studied in detail. The number of superconducting elements in the periodic system has thus been increased appreciably. From measurements of critical fields over a wide range of temperature and pressure, the form of the change in the density of states at the Fermi surface under pressure has been deduced for nontransition metals. The first experiments on the influence of pressure on the tunneling effect in superconductors provide new information on the nature of the change in phonon and electron energy spectra of metals under hydrostatic compression. Results are given for the effect of pressure on the properties of transition metals and alloys. The results obtained are related to the microscopic theory of superconductivity. (auth) (UK)

48872 MODEL FOR SUPERCONDUCTORS, Kobelev, L. Ya.; Yurovskikh, Yu. P. (Ural State Univ., Sverdlovsk, USSR). Fiz. Metal. Metalloved., 28: 175-7(July 1969). (In Russian).

The possibility of using a model of one-dimensional conductors was analyzed by simple generalization of a model developed by G. G. Kuper (Phys. Rev., 150: 189(1966)). The model represented a long thin tube filled with electrons and placed in a dense electron medium in which the screening of Coulomb repulsive electrons inside of the tube was achieved by denser media outside the tube. The concept of one-dimensional superconductivity within the three-dimensional problem was formulated as a conductivity resulting from gravitational forces produced by indirect interactions between electrons (in metals and alloys) or by polarization of polymer side chains and which can exist only in the presence of the necessary controls producing superconductivity by means of three-dimensional forces acting on the one-dimensional chain from the side of surrounding media. (R.V.J.)

48873 TERNARY SUPERCONDUCTING ALLOYS OF THE TITANIUM–NIOBIUM–VANADIUM SYSTEM. TRANSITION TEMPERATURE VARIATION. Bellin, P. H.; Sadagopan, V.; Gatos, H. C. (Massachusetts Inst. of Tech., Cambridge). J. Appl. Phys., 40: 3982-4(Sept. 1969).

The superconducting transition temperature (T_c) variation in the bcc region of the titanium–niobium–vanadium ternary system was studied. Cold-rolled alloys at 10% composition intervals were employed. The T_c values were found to vary smoothly with composition. The highest value in the ternary system was $T_c = 8.8$°K for $Ti_{0.6}Nb_{0.3}V_{0.1}$. The largest decrease in superconducting properties, relative to the Ti binaries, occurred at the first 10% addition of the third element. Additions of Nb to the Ti–V system and of V to the Ti–Nb system led to more sharply defined peaks in the T_c versus n relationship (n stands for the average number of valence electrons per atom) than found in the binaries. The T_c maximum occurred at n = 4.5 for the ternaries with constant vanadium concentration and between n = 4.4 and 4.5 for constant niobium concentration. The minimum of T_c in the Nb–V system was found to shift towards higher Nb concentrations with increasing content of Ti. The T_c values were taken to reflect the density of states at the Fermi surface N(0) and their variation was found to be consistent with the rigid d-band model. (auth)

48874 "DIP EFFECTS" IN THE FLUX-FLOW RESISTANCE IN HIGH-PURITY NIOBIUM. Slettenmark, B.; Astroem, H. U. (Royal Inst. of Tech., Stockholm). J. Appl. Phys., 40: 3985-7 (Sept. 1969).

The flux-flow resistance in the mixed state of single crystallites of high-purity niobium (RRR ~ 10,000) was investigated by a sensitive ac method. A dip in the flux-flow resistance at a transverse magnetic field H_a close to H_{c2}, which is equivalent to the well-known "peak effect," was observed. In addition to this a dip at a lower field H_b was observed in some samples. The dip at H_b appeared to be independent of temperature while the dip at H_a exhibited the same temperature dependence as H_{c2}. The dips had a width of 10 to 20 G. After a slight plastic deformation the dip at H_b appeared to vanish while the dip at H_a became stronger and broader. Different mechanisms for the dips are discussed, but since none completely describe the experimental results, it is concluded that two independent mechanisms for pinning of the flux-line lattice ought to be considered in order to explain the observations. (auth)

48875 ANGULAR DEPENDENCE OF THE CRITICAL FIELD OF QUENCHED THIN Pb AND Sn FILMS. Schiller, Charles K.; Bulow, H. (Wayne State Univ., Detroit). J. Appl. Phys., 40: 4179-83(Sept. 1969).

Resistive critical field measurements were performed in quenched pure Pb and Sn films of 1900- and 650-Å thicknesses with randomly oriented crystals both following the condensation on a quartz plate at 6.2° and 4.1°K and during annealing. In particular, the dependence of the critical field of these quenched metal films on the angle between the magnetic field direction and the film surface was investigated. The experiments show that the theory of the behavior of the critical field of thin metal films as presented by Tinkham, based on the concept of flux quantization and vortices, provides a very good description for these quenched metal films. The good agreement between experimental results and theoretical predictions for several annealing temperatures suggests, in addition, that nominal crystal size and defect concentration do not greatly affect the angular dependence of the critical field. (auth)

Plasma and Thermonuclear Physics

Confinement and Heating

48876 (MATT-Trans-90) PARADOX IN PLASMA DIFFUSION IN TOROIDAL MAGNETIC TRAPS. Galeev, A. A.; Sagdeev, R. Z. (Akademiya Nauk SSSR, Novosibirsk. Institut Yadernoi Fiziki). Translated for Princeton Univ., N. J., from a Russian report. 37p. Dep. CFSTI.

Relaxation of a plasma to a quasi-stationary state is treated on the basis of the momentum balance equations for free and trapped particles. Plasma diffusion in the quasi-stationary state is ambipolar and does not depend on the magnitude of the radial electric field. However, in the process of collisional relaxation, "self-diffusion" of the ion component of the plasma takes place. This leads to the establishment of a self-consistent electric field of the magnitude found earlier. The coefficients of thermal diffusion and thermal conductivity are calculated for both plasma components. (auth)

48877 METHOD AND APPARATUS FOR ELECTROMAGNETICALLY CONTAINING A PLASMA. Cann, Gordon L. (to Xerox Corp.). U. S. Patent 3,467,885. Filed May 20, 1965.

A method and apparatus for plasma containment are disclosed in which a longitudinally continuous magnetic field symmetric about an axis converges the plasma produced by a radial electric discharge at a single axial location to a remote pinch and allows it to diverge thereafter. (auth)

48878 STUDY OF THE DIFFUSION OF HIGH-β PLASMA IN A THETA PINCH. Bodin, H. A. B.; Newton, A. A. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). Phys. Fluids, 12: 2175-84(Oct. 1969).

A direct measurement is described of the perpendicular diffusion coefficient in a theta pinch operating in the low-pressure regime with zero bias field. The diffusion was studied by comparing the measured time variation of the radial electron density distribution with computations assuming classical and other resistivities. A coil 8 m long is used in order to delay end effects and measurements confirm theoretical predictions that the plasma in the midplane is uninfluenced by the ends and free of energy losses for about 25 μsec. The plasma temperature was varied from 90 to 160 eV and the values of density and beta on the axis are $3-4 \times 10^{16}/cm^3$ and 0.7, respectively. In the early stages (before 2 μsec) diffusion at approximately the Bohm rate is found, and this is believed to be due to a streaming mechanism. At later times the measured diffusion coefficient is in good agreement with the classical value in all conditions studied, and the experimental error is such that diffusion is unlikely to exceed $^1/_{10}$ of the Bohm rate. (auth)

48879 ION CYCLOTRON HEATING IN THE MODEL C STELLARATOR. Rothman, M. A.; Sinclair, R. M.; Brown, I. G.; Hosea, J. C. (Princeton Univ., N. J.). Phys. Fluids, 12: 2211-24(Oct. 1969).

A new ion cyclotron resonance heating system has been installed on the Model C stellator. Use of low-power rf during the entire Ohmic heating pulse shows that the density for optimum coupling is a factor of 1.5 to 2 greater than that calculated from a simple theory. The variation of coupling with density and plasma radius is found to agree with theory. An anomalous second maximum in the coupling curve is found. At 1 MW power levels, little energy is transmitted around the U bends by ion cyclotron waves, and it is necessary to have magnetic beaches adjacent to the Stix coil. Best heating is obtained with the least amount of magnetic beach. Use of a larger axial field gradient results in rapid loss of density under the Stix coil, with subsequent decrease in coupling and heating. The maximum ion temperature obtained in the U bends is ~550 eV, uniform to within 20%. A model is proposed in which cooling is dominated by particle losses and charge exchange, the particle loss rate being dependent on kT_e. (auth)

Diagnostics

Refer also to abstract 48952.

48880 (AD-690193) SPECTROSCOPIC STUDIES OF A LASER-PRODUCED PLASMA IN HELIUM. Braerman, W. F.; Stumpfel, C. R.; Kunze, H. J. (Ballistic Research Labs., Aberdeen Proving Ground, Md.). May 1969. 37p. (BRL-1434). CFSTI.

A highly ionized plasma was produced by laser-induced breakdown in helium at a pressure of 360 torr. Line and continuum emission from the plasma were studied as a function of time and of position along the axis of the laser beam. Plasma parameters were then deduced from Stark widths, line-to-continuum, and line-to-line intensity ratios. The applicability of the various methods to the case of a rapidly decaying laser-produced plasma is discussed. The decay of the plasma is analyzed, and the observed decay coefficients are compared with theoretical calculations. (auth) (USGRDR)

48881 ON THE SCATTERING OF LIGHT FROM A NON-MAXWELLIAN PLASMA. Kegel, W. H. (Institut fuer Plasmaphysik, Garching, Ger.). Phys. Lett., 29A: 681-2(Aug. 25, 1969).

It is shown that the experimental results of Ringler and Nodwell can be explained by assuming the electron distribution function to be not exactly Maxwellian but to be composed of 95% hot (60,000 °K) electrons and 5% cold (2000 °K) electrons. (auth)

48882 PLASMA DENSITY MEASUREMENT BY CAVITY PERTURBATION IN HIGH DENSITY PLASMA. Lieberman, M. A.; Lichtenberg, A. J. (Univ. of California, Berkeley). Phys. Fluids, 12: 2109-16(Oct. 1969).

A TM_{010}, time-resolved, cavity perturbation technique has been used to measure the total number of electrons N_e in a magnetic mirror compression experiment ($T_e \sim 75$ keV; $n_e \sim 10^{12}-10^{13}$ cm^{-3}; plasma length ~10 cm; plasma diameter ~0.5 cm; cavity length ~30 cm; cavity diameter ~10 cm). N_e is measured independently of the plasma density profile and in a high plasma density regime ($\omega_p > \omega_{010}$). High density measurements are possible because the plasma skin depth is greater than the plasma diameter and because the induced charge at the ends of the plasma is small. A swept-frequency, raster presentation is used so that the variation of N_e with time can be followed. The measurements show that $N_e \sim 10^{12}$ to 10^{13} at peak compression, and that N_e decays on a time scale ~4 msec. The cavity measurements were in substantial agreement with synchrotron radiation and light measurements, as well as with simple mirror theory. (auth)

48883 DENSITY AND POTENTIAL DISTRIBUTION IN A CYLINDRICAL BEAM-GENERATED PLASMA. Ma, Chao-hung (Univ. of Mississippi, University); Johnson, Curtis C. Phys. Fluids, 12: 2158-61(Oct. 1969).

A static theory of density and potential distribution in a cylindrical beam-generated plasma is presented. The theory requires only minor modifications of the Langmuir–Tonks free-fall theory for a positive column and is based on the assumption that the electron is the principal source of ionization. Both theoretical and experimental results for a singly ionized mercury plasma are given for the case of an electron beam partially filling a cylindrical tube. (auth)

48884 PROBE INTERFEROMETER MEASUREMENT OF ELECTRON DENSITY DISTRIBUTION IN A DECAYING HYDROGEN PLASMA. Brand, G. F.; Heckenberg, N. R. (Univ. of Sydney). J. Appl. Phys., 40: 4209-10(Sept. 1969).

A simple system capable of measuring directly the electron density profile across a plasma was designed and used to investigate the afterglow of a hydrogen plasma. The circuit consists of three ordinary wave interferometers. The probe interferometer operates at 35 GHz over a variable path length. The transmitting horn is placed at a port midway along the vessel while the receiving antenna consists of a length of RG96/U waveguide modified to provide sideways directivity. (M.O.W.)

48885 PULSED LANGMUIR PROBE MEASUREMENTS IN A HELIUM AFTERGLOW PLASMA. Blue, E.; Stanko, J. E. (Lockheed Palo Alto Research Lab., Calif.). J. App. Phys., 40: 4061-7(Sept. 1969).

The electron-temperature history and density decay rate of a 1 torr pulsed helium afterglow plasma were studied with electrostatic probes. The plasma was repetitively formed by electrodeless rf breakdown at 21 MHz. A cylindrical double probe was positioned at the center of the plasma and, in addition, two large metal electrodes were mounted on the inner cylindrical walls of the plasma container. The arrangement of electrodes allowed for both symmetric double-probe measurements and single-probe measurements. A new pulsed probe technique was developed which makes it possible to limit the plasma depletion by the probe to that of a floating probe. At early times in the afterglow ($0 \leq t \leq 2$ msec) the electron energy distribution was found to be non-Maxwellian with two energy groups of electrons. At late times in the afterglow the electron energy distribution was found to be Maxwellian with a temperature corresponding to the ambient temperature. In the case of the single-probe measurements the accuracy of the temperature determination is a new result which indicates that a correct collisional probe model must predict a linear region in the semilogarithmic plot of the probe characteristic. (auth)

48886 ASSESSMENT OF FOCUSED MICROWAVE SYSTEMS FOR PLASMA DIAGNOSTICS AGAINST ELECTROSTATIC PROBES. Richard, C.; Carswell, A. I. (Radio Corp. of America, Ltd., Montreal). J. Appl. Phys., 40: 4184-95(Sept. 1969).

A simplified approach in the use of focused microwave systems for the investigation of radially varying plasmas is assessed by comparison to electrostatic probes on a dc arc argon jet. The approach consists in the mathematical inversion into a radial electron density distribution, of a fit to the phase shift profile obtained by scanning a focused interferometer across a cylindrical plasma. A close fit given by Bockasten's coefficient method, and a loose fit utilizing a modified Gaussian, are considered. The assessment covers a wide range of radial refractive index gradients (as large as 0.4/cm) with electron density up to critical on axis. The modified Gaussian fit approach shows a maximum disagreement of 25% relative to the probe results for an impact parameter smaller than 0.5 and 350% across the plasma jet. A simple modification to the method would apparently permit the reduction of the overall discrepancy to less than 30%. The close fit is found to yield discrepancies which are worse by a factor of 2 to 3. (auth)

Kinetics (General)

48887 (NP-18027) WILLS PLASMA PHYSICS DEPARTMENT SEVENTEENTH SIX-MONTHLY PROGRESS REPORT, JANUARY 1-JUNE 30, 1969. (Sydney Univ. (Australia)). 9p. (PR-17). Dep. CFSTI (U. S. Sales Only).

Continuing research is briefly described for the following: (1) plasma sources, (2) hydromagnetic ionizing fronts, (3) hydromagnetic wave propagation in axially nonuniform magnetic fields, and (4) laser diagnostics. (M.O.W.)

48888 (ORO-3895-7) HELIOS PROGRAM. Progress Report. Robertson, Harry S. (Miami Univ., Coral Gables, Fla. Dept. of Physics). Aug. 15, 1969. Contract AT(40-1)-3895. 19p. Dep. CFSTI.

Basic data on the design and construction of the Helios device are described. Research on cesium arc plasmas is also briefly discussed. (M.O.W.)

Kinetics (Experimental)

48889 (AD-689439) A DESCRIPTION OF LASER-PRODUCED PLASMAS. II. MICROSCOPIC PROCESSES. Allen, Frank J. (Ballistic Research Labs., Aberdeen Proving Ground, Md.). Apr. 1969. 32p. (BRL-MR-1975). CFSTI.

Several experiments are described which, taken together, show that processes other than acceleration in transient electric fields are of considerable importance in the production of the energetic ions observed in laser-produced plasmas. Alternative mechanisms are proposed and analyzed and some of the microscopic processes which take place in the plasma are discussed. A consistent explanation of the experimental results, some of which are quite fragmentary, is provided. The need is pointed out for good time- and space-resolved experiments in order to gain a more detailed understanding of the processes that take place in laser-produced plasmas. (auth) (USGRDR)

48890 (N-69-30622) REFRACTIVE INDEX: PARTICLE DENSITY OF NONEQUILIBRIUM CESIUM PLASMAS PROBED BY A MULTIFREQUENCY HELIUM-NEON LASER. Lancashire, Richard B. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). July 1969. 24p. (NASA-TN-D-5328). CFSTI.

The refractive index of a nonequilibrium cesium plasma is computed for the free electrons and neutral atoms ($6S_{\frac{1}{2}}$ to $7P_{\frac{1}{2}}$ levels) at laser wavelengths of 0.6328, 1.1523, and 3.3914 μm. Densities of the neutrals were computed using quasi-steady-state solutions to the various level rate equations for typical thermionic diode conditions (initial cesium atom densities from 10^{15} to 10^{17} cm^{-3} and electron temperatures from 1500° to 3000°K). The dominant contributors to the refractive index are the ground-state neutrals and the free electrons. The results indicate the usefulness of the technique to measure local cesium atom densities accurately. (auth) (STAR)

48891 MICROWAVE SCATTERING DUE TO ELECTRON PLASMA-WAVE INSTABILITY. Arunasalam, V.; Sinnis, J. (Princeton Univ., N. J.). Contract AT(30-1)-1238. Phys. Rev. Lett., 23: 635-8(Sept. 22, 1969).

An experimental analysis is made of the scattering of microwaves by the density fluctuations due to electron plasma-wave instability in a beam-plasma system. Reasonably good (i.e., within an order of magnitude) agreement is obtained with the Shapiro-Drummond-Pines theoretical estimate of the energy associated with the "linearly unstable" electron plasma waves at "quasilinear" steady state. (auth)

48892 INTERACTION OF MOVING PLASMA WITH TRANSVERSE MAGNETIC FIELD. Goryachev, V. L.; Sukhov, G. S. Magn. Gidrodin., Akad. Nauk Lat. SSR, No. 1, 143-6(Jan.-Mar. 1969). (In Russian).

A strong magnetogasdynamic interaction of a plasma stream with a transverse magnetic field was obtained in the working channel of a shock tube. The formation of a nonstationary drop in density, propagated upwards along the stream, was observed in the zone of interaction. The effects of the density of the cross current, the inductions of the magnetic field, and the lengths of the zones of interaction on the rate of extension of the drop in density were determined. (tr-auth)

48893 SHIFTS AND SELF-REVERSED LINES IN THE VUV SPECTRA OF HIGHLY IONIZED ATOMS IN LASER-GENERATED PLASMAS. Valero, Francisco P. J.; Goorvitch, David; Fraenkel, Benjamin S.; Ragent, Boris (Ames Research Center, Moffett Field, Calif.). J. Opt. Soc. Amer., 59: 1380-1(Oct. 1969).

This work was undertaken to investigate the possibility of the occurrence of appreciable shifts and asymmetries in lines of the vuv spectra emitted from laser-generated plasmas, as well as the possible existence in these spectra of the satellite lines reported by Fraenkel, Goldsmith, and Feldman. Observations were made of spectral lines in the 50- to 300-Å range obtained from Fe, Al, and Be plasmas generated by the radiation from giant-pulse, Q-switched lasers. (M.O.W.)

48894 NONEQUILIBRIUM ELECTRICAL CONDUCTIVITY OF A POTASSIUM-SEEDED ARGON PLASMA. Sakao, Fujihiko; Sato, Hiroshi (Univ. of Tokyo). Phys. Fluids, 12: 2063-71 (Oct. 1969).

Experiments have been made on the electrical conductivity of a nonequilibrium, potassium-seeded argon plasma at atmospheric pressure. The gas is heated uniformly in a vacuum heater up to a temperature of 1700°C. Electric field in the plasma is determined by electrostatic probes as a function of the current density through the plasma, which ranges from 10^{-5} to $2 A/cm^2$. For small current density, the plasma is in thermal equilibrium and the conductivity is independent of the current density. The average momentum transfer cross section between electron and potassium atoms estimated from the equilibrium conductivity is 2.3×10^{-14} cm^2. As the current density is increased the conductivity decreases, reaches a minimum, and then increases. When the current density is not small, the plasma is not in thermal equilibrium and the distribution function of electrons is not Maxwellian. The decrease of the conductivity is explained by considering inelastic collisions between electrons and potassium atoms and the radiation loss from the plasma. The apparent conductivity at large current density is much higher than the equilibrium value; although the uniformity of the current density was not assured. (auth)

48895 PROPERTIES OF MAGNETICALLY BALANCED ARCS. Nicolai, Leland M.; Kuethe, Arnold M. (Univ. of Michigan, Ann Arbor). Phys. Fluids, 12: 2072-82(Oct. 1969).

Experimental results on steady magnetically balanced arcs in supersonic external flows are presented and analyzed, along with investigations elsewhere in subsonic flows, to determine the important similarity parameters. The studies indicate that the steady arc has a central core, impervious to the external flow, within which differential Lorentz forces generate a circulation analogous to that generated by gravity forces in nonuniformly heated gas in a horizontal tube. The conservation equations indicate that a "Lorentz convection parameter," analogous to the Grashof number in free convection phenomena, is an important similarity parameter over a significant range of arc variables. A "characteristic velocity" for the core circulation is indicated. The similarity parameters that provide the interpolation between the properties of subsonic and supersonic balanced arcs indicate the approximations permissible for a first-order solution to the internal circulation. It is inferred from the results that to a first approximation the thickness of the enthalpy boundary layer varies linearly with the reciprocal of the Reynolds number of the external flow. (auth)

48896 DISCHARGE IGNITION IN THE PENNING CELL WITH DIFFERENT GASES. Isakaev, E. Kh.; Reikhrudel, E. M. (Moscow State Univ.). Radiotekh. Elektron., 13: 1663-8(Sept. 1968). (In Russian).

Discharge ignition in the Penning cell in air, He, Ne, Ar, and Xe at pressures of 10^{-4} to 10^{-6} mm Hg were studied. With the lowering of pressure the influence of the type of gas becomes more effective. Experimental results are compared with estimated ignition curves $H_3 = f(V_a)$ conducted earlier (Zh. Tekh. Fiz., 36: 653(1966)). Also studied were ignition curves and discharge

quenchings $V_a = f(H)$ and charged-particle currents according to the cathode radius. In areas close to the curve $V_a = f(H)$ redistribution of current occurs according to radius. Such a redistribution explains greater time delays of ignitions previously observed in discharges at pressures of 10^{-4} to 10^{-6} mm Hg. The relation of the discharge formation time to the pulsed power supply of the discharge gap was studied. (auth)

48897 STANDING SHOCK IN A DIPOLE FIELD. Ben-Yosef, N.; Rubin, A. G. (Air Force Cambridge Research Labs., Bedford, Mass.). J. Appl. Phys., 40: 4074-7(Sept. 1969).

A standing bow shock is produced in the flow of a plasma into a dipole magnetic field. The flow direction is perpendicular to the magnetic field. The structure of the bow shock is investigated by measurements of particle density, electron temperature, magnetic field, and magnetic field oscillations. It seems that the oscillations are generated inside the shock which are strongly damped in the upstream direction. (auth)

Kinetics (Theoretical)

Refer also to abstracts 48605, 49022, and 49023.

48898 (AD-689230) SOME STUDIES OF THE KINETIC STATE OF AN EXCITED GAS OR PLASMA INTERACTING WITH RADIATION. Koutsoyannis, Sotiris P.; Karamcheti, Krishnamurty (Stanford Univ., Calif. Dept. of Aeronautics and Astronautics). Mar. 1968; Revised Mar. 1969. Contract Nonr-225(61). 180p. (SUDAAR-327). CFSTI.

Some basic experimental and theoretical studies relating to the general problems of determining the kinetic state of a gas are described. Specifically, the studies are concerned with deducing the kinetic state from experimentally observed profiles (shapes) and total intensities of spectral lines of a gas. For the experimental studies, a dc excited monatomic gas column consisting of ^{20}Ne or ^{22}Ne or a mixture of another inert gas (mainly ^{4}He) is employed. The variations with pressure, discharge current, and discharge wall temperature of the absorption profile parameters such as the maximum absorption coefficient, the shift, the width, and the line shape of the profile, are presented. To account for the observed results, line shape theories were developed. The important excitation and de-excitation processes, as well as the effects of some plasma properties, such as the electron number density and electron temperature of the population processes, were assessed. Difficulties of applying such theories to small-diameter and low-pressure discharges are discussed. Finally, kinetic equations describing the kinetic state of an excited monatomic gas interacting with radiation are developed, taking into account collisional and radiative processes. (USGRDR)

48899 (AD-690128) EFFECT OF A BOUNDARY ON THE BEAM PLASMA INSTABILITY. Evans, Kenneth Jr.; Jackson, E. Atlee (Illinois Univ., Urbana. Coordinated Science Lab.). July 1969. Contract DAAB07-67-C-0199. 11p. (R-422). CFSTI.

In recent years there has been considerable interest in the spatial-temporal growth of instabilities arising when a beam is injected into a plasma. There does not appear, however, to be any theoretical treatment of the modification of the growth of an initial perturbation due to the presence of a spatial boundary. This modification is illustrated for the case of a monoenergetic electron beam injected into a cold plasma with an infinitely massive ion background. The treatment is based on the linearized hydrodynamic equations and Maxwell's equations for the normalized densities, the drift velocities, and the electric field. (auth) (USGRDR)

48900 STATISTICAL DISTRIBUTION OF BREAKDOWN TIME-LAGS BY THE TOWNSEND MECHANISM UNDER HIGH-ENERGY-PARTICLE IRRADIATION. Tagashira, H.; Sakamoto, S. (Hokkaido Univ., Sapporo). J. Phys., D (London), 2: 1193-1202(Sept. 1969).

Recent experimental work suggests that the simultaneous generation of more than one initial electron by a single irradiation particle in a discharge gap has important effects in the statistical distribution of breakdown time lags by the Townsend mechanism. To take account of these effects, earlier theories as given by Legler (1955, '56), are extended in the present paper. General formulae for time-lag distributions are obtained and typical numerical examples are compared with a digital computer simulation study to confirm the consistency of the calculations and to find the limitation due to approximation. An approximate, but direct, method of measuring the formative time-lag distribution when breakdown is initiated by a single electron is suggested. (auth) (UK)

48901 IONIZATION EQUILIBRIUM AND RADIATIVE COOLING OF A LOW-DENSITY PLASMA. Cox, Donald P. (Univ. of California, San Diego); Tucker, Wallace H. Astrophys. J., 157: 1157-67(Sept. 1969).

The results of calculations of the ionization equilibrium and rate of radiative cooling of a high-temperature low-density plasma are presented. The elements H, He, C, N, O, Ne, Mg, Si, and S are considered, and the temperature range is taken to be 10^3 to 10^8°K. Electron collisions are assumed to be the only ionizing agent. The effect of the process of dielectronic recombination is seen to be most important for temperatures between 10^5 and 10^6°K. The radiative losses due to bremsstrahlung, recombination radiation, and collision-induced line emission are considered. For a gas with the cosmic abundances, the line emission due to 2s-2p transitions in oxygen ions produces a large peak in the cooling curve near 2×10^5°K. (auth)

48902 PERIODIC SMALL-AMPLITUDE SOLUTIONS TO VOLTERRA'S PROBLEM OF TWO CONFLICTING POPULATIONS AND THEIR APPLICATION TO THE PLASMA CONTINUITY EQUATIONS. Roth, J. Reece (Lewis Research Center, Cleveland). J. Math. Phys. (N.Y.), 10: 1412-14(Aug. 1969).

The coupled set of first-order nonlinear differential equations describing a generalized form of Volterra's problem of two conflicting populations $\dot{x} = C_0 + C_1x + C_2y + C_3xy + C_4x^2 + C_5y^2$, $\dot{y} = A_0 + A_1x + A_2y + A_3xy + A_4x^2 + A_5y^2$ are solved by an approximate method which gives y(t) for the particular case in which the variables x and y vary periodically, the coefficients C_i and A_i are real, and the peak-to-peak amplitude of x is small compared with the mean value of x. The peak-to-peak amplitude of y, however, is not necessarily small compared with the mean value of y. When these conditions are satisfied, the functional form of y(t) is approximated by Jacobian elliptic functions. The solutions obtained in this analysis are relevant to special cases of the classical problem of predator and prey, and also to certain low-frequency oscillations in partially ionized plasmas that arise from periodic solutions to the neutral and charged-particle continuity equations. (auth)

48903 POSSIBLE INSTABILITY OF THE CUT-CONTRIBUTIONS TO THE RING EQUATIONS. Baus, M. (Univ. of Brussels). J. Math. Phys. (N.Y.), 10: 1494-7(Aug. 1969).

The specifically relativistic cut contributions to the ring equations of a relativistic plasma as discussed in a previous paper are considered in more detail. The question of principle—whether or not these contributions can give rise to specifically relativistic instabilities—is investigated with the aid of a simple nonequilibrium velocity distribution which leads to unstable cut contributions, but not necessarily to unstable Landau-pole contributions. (auth)

48904 TRANSVERSE DIELECTRIC TENSOR FOR A FREE-ELECTRON GAS IN A UNIFORM MAGNETIC FIELD. Arunasalam, V. (Princeton Univ., N. J.). J. Math. Phys. (N.Y.), 10: 1305-13(Aug. 1969).

An elementary method of calculating that part of the tensor dielectric coefficient which determines the propagation of transverse electromagnetic radiation through a free-electron gas in a uniform external magnetic field is presented. The method presented here is based on a particle-orbit analysis and is somewhat analogous to a generalized version of the Kramers-Heisenberg quantum theory of gaseous dispersion. It is shown that the elements of the transverse dielectric tensor can be obtained from a knowledge of the quantum-mechanical transition probabilities for emission and absorption of photons (that is, from a knowledge of the Einstein A and B coefficients). The formal expression for the dielectric tensor thus obtained is shown to be valid for both the degenerate and the nondegenerate system of electrons. The dielectric tensor thus obtained is shown to reduce in the classical limit to the familiar results of the conventional classical hot plasma kinetic theory. The first quantum correction to the classical hot plasma dielectric tensor is explicitly given and it is shown that, under suitable conditions, this quantum correction will play a significant role in the analysis of the experimental studies of the electrodynamic behavior of "classical electron-hole plasmas" in a uniform external magnetic field. (auth)

48905 A NEW PROOF OF SUPERPOSITION OF DRESSED PARTICLES IN PLASMA KINETIC THEORY. So, K. C.; Liu, C. H. (Univ. of Illinois, Urbana). J. Phys., A, 2: 605-10(Sept. 1969).

A new proof is given by using the generalized stochastic equation for the conditional probability density of one particle given the position in phase space of another particle. The conditional probability density of any particle given a specific particle is shown to satisfy the Vlasov equation from which a Markov-type integral results. The superposition principle is established without the explicit introduction of test particles. Relations to Rostoker's results are discussed. (auth) (UK)

48906 RELATIVISTIC RING EQUATIONS. II. A NON-PERTURBATIVE APPROACH. Baus, M. (Univ. Libre, Brussels). Physica, 43: 517-27(Sept. 1, 1969).

It is shown that this nonperturbative approach leads to a straightforward deductive derivation of the relativistic ring equations. However, the complete set of coupled kinetic equations derived in paper I which include radiation and field reaction terms, can not as yet be obtained by this method so that its validity is actually restricted to the strongly stable collision region. The connections with similar nonperturbative approaches (superposition principle of dressed test particles, microscopic approach) is briefly discussed. (auth)

48907 ON THE PROBLEM OF FINITE PARTITION FUNCTIONS FOR HYDROGEN PLASMAS. Dalenoort, G. J. (FOM-Instituut voor Plasma-Fysica, Jutphaas, Netherlands). Physica, 43: 578-80(Sept. 1, 1969).

One way to obtain finite partition functions for hydrogen plasmas is to introduce a cutoff in order to get a nondiverging series: $Z = \Sigma_{n=1}^{n^*} g_n e^{-E_n/KT}$, where g_n and E_n are the degeneracy and energy of level n, respectively. Unsoeld provided a semiclassical model to calculate $n.^*$ Instead of the above equation a cutoff $n^*(F)$ is proposed for each subensemble of atoms, which experience a field F. For the partition function, one then obtains (restriction to isotropic systems): $Z = \int d^3F\ P(F) \Sigma_{n=1}^{n^*(F)} g_n e^{-E_n/KT}$, where P(F) is the probability density for an electric field of size E. (M.O.W.)

48908 CALCULATED ELECTRON ENERGY DISTRIBUTION FUNCTIONS FOR DISCHARGES IN HELIUM AND HELIUM–ARGON MIXTURES. Postma, A. J. (Euratom–FOM, Jutphaas, Netherlands). Physica, 43: 581-95(Sept. 1, 1969).

Electron energy distribution functions, electron mobilities, and inelastic collision rates were calculated for discharges in helium and helium–argon mixtures. The processes taken into account are elastic and inelastic electron–atom collisions, mutual interactions between electrons, and collisions between electrons and ions. (auth)

48909 RADIATION FIELDS OF ENERGETIC ELECTRONS IN HELICAL ORBITS WITHIN A MAGNETOACTIVE PLASMA. Sakurai, K. (Goddard Space Flight Center, Greenbelt, Md.); Ogawa, T. Planet. Space Sci., 17: 1449-58(Aug. 1969).

The radiation fields produced by an energetic electron which is moving in helical orbit in a magnetoactive plasma are derived by solving Maxwell's equations exactly. These fields consist of three components which are characterized by different wave frequencies related to the anisotropic nature of the medium. The result obtained seems to be useful in investigating the suppression of the low frequencies of solar radio type-IV bursts and galactic emission, and suggests that the explanation for the influence of ambient plasmas on the gyro-synchrotron radiation from energetic electrons must be modified. (auth) (UK)

48910 ENERGY LOSS OF FAST TEST IONS IN A PLASMA IN A WEAK MAGNETIC FIELD. May, R. M.; Cramer, N. F. (Univ. of Sydney). Phys. Lett., 30A: 10-11(Sept. 8, 1969).

A detailed account is given of the effect of a weak magnetic field on the rate of energy loss by a fast test ion in a plasma ("weak" field means of the electron cyclotron frequency is less than the plasma frequency). (auth)

48911 NONLINEAR RADIAL SELF-FOCUSING OF A MODULATED ELECTRON BEAM IN A PLASMA. Krasovitskii, V. B.; JETP Lett. (USSR) (Engl. Transl.), 9: 422-5(June 20, 1969).

Translated from Zh. Eksp. Teor. Fiz., Pisma Redaktsiyu, 9: 679-83(June 20, 1969).

The interaction of a plasma with a strongly modulated electron beam, constituting a sequence of charged discs with a surface charge density $\sigma(r)$ located at distances l from one another and moving with velocity v_0, can be described by introducing into the Maxwell equations for the fields produced by the beam the dielectric constant of the plasma $\epsilon(\omega_M) = 1 - \omega_p^2/\omega_M^2$. This quantity describes sufficiently well the electromagnetic properties of the plasma if the beam modulation frequency $\omega_M = 2\pi v_0/l$ is close to the plasma frequency ω_p: $|\omega_M - \omega_p| \ll \omega_p$. Since the frequency ω_M is determined only by the beam parameters and does not depend on the plasma density, the dielectric constant of the plasma is negative when the condition $\omega_M < \omega_p$ is satisfied, and the Coulomb repulsion of the beam electrons gives way to attraction. When the transverse dimensions r_0 of the plasmoids are large compared with the distances between them, $r_0 \gg l$, and consequently the field produced by the plasmoids is parallel to the beam motion ($E_z > E_r$, where E_z and E_r are respectively the longitudinal and transverse components of the beam field), this effect leads to a shift of the plasmoids in a longitudinal direction, as a result of which an instability develops in the plasma–beam system, with a frequency $\omega = \omega_M < \omega_p$. In the opposite limiting case $r_0 \ll l$, considered in detail, the transverse field component E_r greatly exceeds the longitudinal one E_z, and the main effect is the interaction of the electrons of each plasmoid with the transverse field, leading to a radial compression of the beam. The stationary state is established when the focusing Coulomb force becomes equal to the force due to the gradient of the kinetic pressure in the beam, which leads to defocusing. (M.O.W.)

48912 ENHANCED BREMSSTRAHLUNG FROM PLASMAS WITH RELATIVISTIC ELECTRON TAILS. Papadopoulos, Konstantinos (Univ. of Maryland, College Park). Phys. Fluids, 12: 2185-93(Oct. 1969).

The bremsstrahlung emitted from thermal plasmas which coexist with a flux of relativistic electrons is calculated. The emission is found to be greatly enhanced at the fundamental and second harmonic of the electron plasma frequency. Some possible astrophysical applications of the theory are discussed. (auth)

48913 ELECTRON DISTRIBUTION FUNCTION FOR A NONEQUIPARTITION PLASMA IN A STRONG ELECTRIC FIELD. Viegas, J. R.; Kruger, C. H. (Stanford Univ., Calif.). Phys. Fluids, 12: 2050-62(Oct. 1969).

Solutions to the kinetic equation of a steady, homogeneous plasma of arbitrary degree of ionization subjected to strong electric fields are developed. Nonelastic as well as elastic encounters are included in the analysis. Expressions for the current density, electrical conductivity, and electron temperature of the plasma are also presented. Numerical results are illustrated for the case when the nonelastic effects are neglected. Calculations are presented showing the transition of the isotropic part f^0 of the distribution function from a gas-temperature Maxwellian at near equilibrium conditions to an electron-temperature Maxwellian under nonequipartition conditions. It was found that whenever the electron–electron to electron–neutral collision-frequency ratio was much greater than the electron-to-heavy-particle mass ratio, f^0 is Maxwellian. When f^0 is Maxwellian, the Chapman–Enskog and Spitzer–Härm conductivity expressions developed for the case of weak electric fields are shown to be applicable for strong electric fields providing that in these expressions the electron temperature replaces the gas temperature. An approximate form for f^0 suggested by Ginzburg is compared with the exact expression. The accuracy of the use of a Maxwellian rather than the nonequilibrium distribution function in the calculation of the electrical conductivity is assessed. (auth)

48914 VALIDITY CONDITIONS FOR LOCAL THERMODYNAMIC EQUILIBRIUM. Drawin, H. W. (CEN, Fontenay-aux-Roses, France). Z. Phys., 228: 99-119(1969).

Validity criteria for partial and complete local thermodynamic equilibrium (L.T.E.) are re-examined on the basis of generalized cross section formulas which are in agreement with experiments and with quantum mechanical results. The validity conditions for L.T.E. obtained deviate both in the absolute values and in the temperature dependence from those given by other authors. The influence of resonance absorption on the establishment of L.T.E. is considered and quantitatively taken into account. The influence of atom–atom collisions on the population densities of highly excited levels is also discussed. A general formula is derived, permitting an estimate of whether the excited levels are populated due to electronic or atomic collisions. The condition obtained is quite severe for plasmas in which the electron temperature is different from the gas temperature. For example: in a helium non-L.T.E. plasma of 1% ionization degree (for $T_e = 2 \times 10^4$°K) all levels of principal quantum numbers $n \sim 12$ will essentially be populated due to atomic collisions at a gas temperature of $T_a = 1.6 \times 10^4$°K. The influence of diffusion on the L.T.E. conditions is discussed for the various kinds of particle interactions. It is found that deviations from L.T.E. due to particle diffusion may be more severe than is generally assumed. (auth)

Production

Refer also to abstract 48889.

48915 (N-69-32778) INVESTIGATION OF THE EFFECT ON PLASMA STRUCTURE IN CASE OF IMPACT OF AN ENERGY ENRICHED MICROPARTICLE. Dietzel, Hagen. Translation of Untersuchungen des Effektes der Plasmabildung biem Aufschlag Energiereicher Mikropartikel, Max-Planck-Institut fuer Kernphysik, Heidelberg, 1969. 41p. (NASA-TT-F-12328). CFSTI.

Plasma formation by impact of high-energy cosmic particles on metal surfaces are investigated as a guide to future flight experimentation, including a charge liberated as a function of particle charge, surface conditions, charge separating field, and angle of incidence. A Van de Graaff generator was used. (auth) (STAR)

48916 GENERATORY NIZKOTEMPERATURNOI PLAZMY. (Low-Temperature Plasma Generators). Koroteev, A. S.; Kostylev, A. M.; Koba, V. V.; Lomovtsev, M. A.; Kutsevalov, V. A.; Cheloznov, B. V. Moscow, Izdatel'stvo Nauka, 1969. 129p.

Methods of generation of low-temperature plasma by electric arc heating in special apparatus, called plasmatrons, are described. Design plans for discharges of several thousand kilowatts and operating systems for use of these plasmatrons are described. Results are given of experimental investigations of plasmatron characteristics as a function of intensity drop of the arc, the emf, and the mean output temperatures, depending on conditions in the discharge chamber. (tr-auth)

48917 FORMATION OF DENSE PLASMA BY INJECTING HIGH-ENERGY ELECTRON BEAM INTO MAGNETIC TRAP MIRROR. Bredikhin, M. Yu.; Il'chenko, A. M.; Maslov, A. I.; Skibenko, A. I.; Skibenko, E. I.; Yuferov, V. B. (Inst. of Physics and Tech., Kharkov). Ukr. Fiz. Zh., 14: 1167-70(July 1969). (In Russian).

The formation of a dense plasma by injecting a high-energy electron beam into magnetic mirror traps is discussed. The obtained dense plasma has the maximum density of (2 to 6) × 10^{14} cm^{-3}, $\beta \sim 0.1$, and $\omega_0 = (10 \text{ to } 12)\omega_{Hi}$. (auth)

48918 CONTRIBUTION TO THE STUDY OF HIGH-INTENSITY ARCS OF NONCYLINDRICAL SHAPE. Hoyaux, M. F. (Univ. of Pittsburgh). High Temp. High Pressures, 1: 83-92 (1969)

An attempt is made to develop a model for a high-intensity arc positive column of non-cylindrical shape, not confined laterally by walls, and which expands freely over a finite length. The method used is based upon the concept of "primitive potential" introduced by the author elsewhere in the literature; it is further assumed, as a starting approximation, that the Laplacian of this potential is zero. Refinements specific to low- and moderate-pressure high-intensity arcs, such as the magnetic self-striction and the Gvosdover effect (reduction in mobility due to Coulomb scattering) are introduced. It is shown that such a column presents instabilities and multideterminations totally absent in a cylindrical column of comparable parameters. The problem of stability of the investigated configurations under magnetic or fluid dynamic perturbations is not discussed. (auth) (UK)

Stability

Refer also to abstracts 48760, 48943, 48944, and 48951.

48919 (D-1-82-876) STABILITY OF INHOMOGENEOUS PLASMAS. Leavens, William M.; Love, C. H. (Boeing Scientific Research Labs., Seattle, Wash. Plasma Physics Lab.). July 1969. 17p.

The stability of realistic, inhomogeneous, plasmas with sheaths is studied by examining the interaction between an electron beam and the discrete, longitudinal, normal modes of a stable, Maxwellian plasma. A weak beam just displaces the discrete plasma eigenfrequencies in a way depending on beam current and energy. For the first four eigenfrequencies ω-plane maps are calculated. Instability is confined to a few intermediate modes, and growth rates are not large. (auth)

48920 APPARENT PARAMETRIC ENHANCEMENT OF A DRIFT-TYPE INSTABILITY. Keen, B. E.; Aldridge, R. V. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). Phys. Lett., 29A: 690-1(Aug. 25, 1969).

Results are presented concerning the apparent enhancement of a "drift-type" instability by pumping it with an external signal at twice the instability frequency. (auth)

48921 EQUILIBRIUM AND STABILITY OF HIGH-CURRENT DISCHARGE IN A LOW-TEMPERATURE PLASMA. Rukhadze, A. A.; Triger, S. A. Zh. Prikl. Mekh. Tekh. Fiz., No. 4, 14-21 (July-Aug. 1969). (In Russian).

Equilibrium and stability of optically dense high-current discharges were studied under conditions of strongly radiant thermal conductivity, resulting in uniform temperature in the equilibrium state and its rapid balancing during oscillations. Dispersion equations were obtained and increments of instabilities were calculated for a simple case of cylindrical z pinch and discharges with inverse axial currents. It was found that in discharges with inverse current, it is possible to maintain the discharge in a state close to equilibrium for the time in which large instabilities, capable of changing the equilibrium state, did not have time to develop. Transparent and dense plasmas were studied at low temperatures ($T \sim 3$ to 10 eV) where the effects of finite conductivity (diffusion of electromagnetic fields in plasma and absence of skin effects) play an important part, while in the case of high-temperature plasma they do not have to be considered. (R.V.J.)

48922 LACK OF EQUILIBRIUM IN A PLASMA BETATRON. Ferrari, L. A. (City Univ. of New York, N. Y.). Phys. Fluids, 12: 2203-5(Oct. 1969).

The motion of charged particles in combined betatron and azimuthal magnetic fields is investigated for the case when the radial betatron focusing force vanishes. (auth)

48923 TUBULAR PINCH AND TEARING INSTABILITY. Anderson, Oscar A. (Univ. of California, Livermore); Kunkel, Wulf B. Phys. Fluids, 12: 2099-2108(Oct. 1969).

Theoretical considerations and previous experimental findings with fast tubular (cylindrical sheet) pinch discharges are reviewed briefly. More recent work with magnetic probes, as well as streak and Kerr cell photography, corroborates that the sheet-current configuration can be sufficiently stable to survive a fair number of pinch oscillations. It is shown, however, that under conditions of high compression the current layer is likely to break up into a set of individual channels because of a resistive instability. The process involves tearing and reconnection of magnetic field lines. Wavelengths and growth rates seem to be in agreement with rough theoretical predictions. The current channels form separate linear pinches, which under certain circumstances disintegrate subsequently by a secondary instability. A generally turbulent behavior results. Tearing is not prevented by superposition of a strong axial magnetic field, again in agreement with theory, although a slight retardation is noted. When deuterium is used in the discharge, neutrons are emitted. Presumably because of the slow rate of reconnection in most of the studies, the neutrons appear mainly during the secondary instability, rather than at the time of tearing. These findings are of interest both to astrophysics and to controlled-fusion research. (auth)

48924 WARM-PLASMA STABILIZATION OF RESONANT LOSS-CONE INSTABILITIES. Dory, R. A. (Oak Ridge National Lab., Tenn.); Farr, W. M.; Guest, G. E.; Callen, J. D. Phys. Fluids, 12: 2117-24(Oct. 1969).

A warm Maxwellian plasma can stabilize velocity-space instabilities which might otherwise occur in a hot non-Maxwellian plasma with which it coexists. The relative densities and temperatures of the two species required for stabilization of resonant ($\omega \approx l\Omega_i$, the ion gyroharmonics) loss-cone modes in a mirror-confined hot-ion plasma are evaluated for a model plasma whose density is spatially uniform but whose velocity-space distribution function simulates the loss-cone effect of mirror confinement. Marginal stability boundaries are given and compared with several simple but inexact criteria. The dominant features of the stability boundaries are explained on the basis of cutoff of propagation of the unstable waves. Temporal growth rates of the absolutely unstable modes are found to decrease significantly with increasing warm-plasma density. The resulting transition from absolute to convective growth is demonstrated for the first two gyroharmonics. (auth)

48925 RECOMBINATION INSTABILITY AS AN EXAMPLE OF A MORE GENERAL CLASS OF INSTABILITIES. Kofoed-Hansen, O. (Risoe Research Establishment, Roskilde, Denmark). Phys. Fluids, 12: 2124-31(Oct. 1969).

The recombination instability described by D'Angelo is shown to constitute an example of a more general class of density change instabilities where overall density changes of gases and plasmas are caused by volumetric processes. A simplified version of the fluid mechanics equations pertaining to this problem is examined both in the linearized case and in the complete nonlinear complexity case. (auth)

48926 DESTABILIZATION AND QUASILINEAR EVOLUTION OF THE ION FLUTE MODE. Horton, C. W. Jr. (Inst. for Advanced Study, Princeton, N. J.). Phys. Fluids, 12: 2132-9(Oct. 1969).

The regions of instability of the ion flute mode are investigated for a low -β plasma in axisymmetric multipoles. A stability criterion is given including the effects of (1) finite Debye length, (2) small temperature anisotropy, and (3) small temperature gradient. Using quasi-linear theory the growth of a spectrum of waves is shown to produce a stabilizing anisotropy. The level of density fluctuations in the saturated state is given for plasmas close to marginal stability. (auth)

48927 TRANSVERSE KELVIN–HELMHOLTZ INSTABILITY IN A ROTATING PLASMA. Kent, Gerald I. (Systems, Science, and Software, La Jolla, Calif.); Jen, Norman C.; Chen, Francis F. Phys. Fluids, 12: 2140-51(Oct. 1969).

In thermally ionized alkali-metal plasmas (Q machines), two types of low-frequency oscillations are found: the usual drift wave localized to the region of large-density gradient, and a higher-frequency wave localized to the region of the radial boundary. The latter "edge" oscillation is shown to be a Kelvin–Helmholtz instability driven by the large shear in plasma rotational velocity at the boundary. An analytic solution of the finite-Larmor-radius dispersion equation for the unstable wave is found by making the simplifying assumption that the rotational velocity jumps discon-

tinuously. The results agree reasonably well with experimental measurements. (auth)

48928 NONLINEAR STABILITY OF A BEAM–PLASMA SYSTEM. Samain, A. (Euratom–CEA, Fontenay-aux-Roses, France) Phys. Fluids, 12: 2152-7(Oct. 1969).

The evolution of a collisionless beam–plasma system initially in a linearly unstable state E adjoining a marginally unstable state E_{cr} is considered. This instability is a reactive effect, not a resonant particle effect. All phenomena are assumed to be periodic with a definite period along the beam direction. An examination is made to see whether a weak turbulence with an intensity depending on the deviation Δ between E and E_{cr} and going to 0 with Δ, or on the contrary a turbulence independent of Δ develops in the plasma. To that end a study is made, using a variational method, to see whether a small-amplitude ergodically periodic potential can exist in the plasma as a result of spontaneous evolution. It is found that this is impossible, and it is concluded that a turbulence with an intensity independent of Δ develops in the plasma. (auth)

48929 STABILITY OF THE RESISTIVE SHEET PINCH. Barston, E. M. (New York Univ., N. Y.). Phys. Fluids, 12: 2162-74(Oct. 1969).

Necessary and sufficient conditions for exponential stability of equilibria are obtained for the resistive, viscous, incompressible magnetohydrodynamic sheet pinch in a gravitational field. Insulating as well as conducting boundaries are considered. The unperturbed magnetic field B_0 (horizontal), resistivity η_0, viscosity ν_0, and mass density ρ_0 are permitted to be arbitrary (neither necessarily constant nor small) functions of the vertical coordinate z consistent with the equilibrium equations. In particular, it is shown that: (1) previous results claiming the existence of an exponentially growing "tearing" mode for a constant η_0 equilibrium with zero gravity are incorrect, (2) a nonconstant η_0 equilibrium with insulating boundaries cannot be gravitationally stabilized, and (3) a nonconstant η_0 equilibrium with $g(d\rho_0/dz) \equiv 0$ and B_0 nonunidirectional is exponentially unstable to all perturbations (i.e., waves of arbitrary wavelength) with certain directions of propagation. (auth)

48930 KINETIC THEORY OF DRIFT-DISSIPATIVE INSTABILITIES OF PLASMA. Rukhadze, A. A.; Silin, V. P. (Lebedev Inst. of Physics, Moscow). Usp. Fiz. Nauk, 96: No. 1, 87-126(Sept. 1968). (In Russian).

Theoretical investigations of recent years concerning stability of the magnetic confinement of plasma with calculation of dissipative effects, dependent both on Cherenkov absorption of waves and electrostatic collisions of charged particle in plasma are surveyed. Analysis of the stability of inhomogeneous plasma is conducted by a unitary method, by means of investigation of spectra of normal modes of oscillations. For this, the kinetic equations of electrons and ions are resolved with the precise integral of Landau collisions. The role of dissipative effects in the spectra of unstable drift oscillations and the stabilizing influence of crossing of the lines of force of magnetic field are analyzed. Specific results, which embrace all of the kinetic range of frequencies of drift oscillations, are shown in six tables given at the end of the article. 49 references. (tr-auth)

Thermonuclear Processes

48931 (IAE–1615) DETERMINATION OF THE BASIC ELECTRICAL AND ENERGY PARAMETERS OF A TOROIDAL SOLENOID. Melikhov, P. I. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Fiziko-Energeticheskii Institut). 1968. 24p. (In Russian). Dep. CFSTI (U. S. Sales Only).

The principal electrical and energy parameters of a toroidal solenoid are determined for two variants of a design execution of winding sections (with constant and linearly varying thicknesses). Simple analytical dependences were obtained for those parameters with an error of not more than ±7%. Graphs are presented which permit, on the basis of the given size of the magnetic field on the solenoid axis and the geometric characteristics, determining the unknown values of its parameters. The error of the graphs does not exceed ±10%. (JPRS)

48932 (LA–4186) CURVES FOR PREDICTING STRESSES IN CONTROLLED FUSION PULSED MAGNETIC FIELD SYSTEMS. Baker, D. A.; Mann, L. W. (Los Alamos Scientific Lab., N. Mex.). May 23, 1969. Contract W-7405-eng-26. 16p. Dep. CFSTI.

A set of curves is given to aid in the prediction of an elastic system response to the impulsive magnetic forces commonly encountered in controlled fusion research. Results for two magnetic field waveforms are given, (1) an exponentially damped sinusoid, and (2) a sinusoidal rise-to-peak field followed by an exponential decay corresponding to the application of a "crowbar" to sustain the field. (auth)

48933 (MATT–709) REACTIVE TRAPPED-ION SOURCE FOR HIGHLY STRIPPED IONS. Stix, Thomas H. (Princeton Univ., N. J. Plasma Physics Lab.). Sept. 1969. Contract AT(30-1)-1238. 27p. Dep. CFSTI.

Considerable current interest is attached to the possibility of producing far-transuranic elements by fusion of heavy nuclei. It has been suggested that the projectile nuclei, brought to a high state of ionization by prestripping in an energetic electron plasma, could be accelerated in conventional accelerators. A new low-dissipation configuration is proposed for the stripping plasma: a thin-slab cloud of energetic electrons is reactively confined in a Phillips Ionization Gauge geometry. Additional anodes help to create an electrostatic potential well that confines the ions during the stripping process. A transverse electric field is used to eject trapped electrons that would otherwise accumulate and neutralize the ion-confining potential maxima. (auth)

48934 (UCRL–71757) TRITIUM BREEDING AND ENERGY GENERATION IN LIQUID LITHIUM BLANKETS. Lee, J. D. (California Univ., Livermore. Lawrence Radiation Lab.). Aug. 27, 1969. 22p. (CONF-690901–3). Dep. CFSTI.

From International Conference on Nuclear Fusion Reactors, Culham, England.

Effects of structure volume fraction and ^{6}Li to Li atom fraction on tritium breeding in a lithium blanket are presented. Tritium and energy generation potential of a number of lithium blanket schemes are compared. Energy generation (fusion plus blanket reactions per gram of natural lithium used) ranged from $\simeq 8.5 \times 10^3$ to $\simeq 2.7 \times 10^4$ kWh. (auth)

48935 (UCRL–71758) THE MODULE APPROACH TO BLANKET DESIGN: A VACUUM WALL FREE BLANKET USING HEAT PIPES. Werner, R. W. (California Univ., Livermore. Lawrence Radiation Lab.). Aug. 13, 1969. 38p. (CONF-690901–2). Dep. CFSTI.

From International Conference on Nuclear Fusion Reactors, Culham, England.

An analysis has been made of the blanket surrounding the thermonuclear plasma which is required to: moderate neutrons, provide for kinetic to thermal energy conversion, remove the thermal energy produced, and regenerate the tritium burned in the D–T reaction. The study introduces two new features to blanket design: heat pipes and a modular structure. The study relocates the "standard" vacuum wall of a thermonuclear reactor outboard of the neutron-moderating, energy-converting blanket and thus places the entire moderator in a vacuum envelope and in an unobstructed view of the plasma. Studies heretofore have had the vacuum wall intervening between plasma and moderator with consequent losses and structural buckling problems. The new blanket is structurally designed in modular units which radially and tangentially interlock to form a neutron closed cylinder. The modules consist of sets of thin walled tube banks which have common mass flow and common pressure requirements so that structural design is simple and replacement straightforward. A reference design operating at ~1100°K and using natural lithium as a moderator and sodium heat pipes is discussed. (auth)

48936 (UCRL–71768) PRELIMINARY DESIGN CONSIDERATIONS FOR AN ASTRON POWER REACTOR SYSTEM. Werner, R. W.; Myers, B.; Mohr, P. B.; Lee, J. D.; Christofilos, N. C. (California Univ., Livermore. Lawrence Radiation Lab.). Aug. 22, 1969. 38p. (CONF-690901–4). Dep. CFSTI.

From International Conference on Nuclear Fusion Reactors, Culham, England.

The study is concerned with the energy conversion in the blanket and reviews a set of compositions for optimized power or tritium generation. These blankets deliver their sensible heat to a Rankine vapor power cycle. The applicable thermonuclear reaction is: $D + T \rightarrow {}^4He + n + 17.6$ MeV. The deuterium–tritium plasma is contained by the field pattern of closed magnetic lines unique to the Astron system. System neutronics are based on variations in composition of Li–Na–Be. The neutronic calculations include the influence of structural design requirements. The blanket is a niobium structure of modular design operating at a maximum temperature of 1150°K. A modular design of the blanket permits fabrication economies and allows replacement of a relatively low-cost neutron-moderating shell on a schedule matched to time for radiation damage. The blanket is subdivided into two basic units: (1) the "throw away" neutron moderating shell, and (2) the long life, substantially zero, neutron environment containment vessel, shields, magnet structure, etc. The reactor total output including charged particle energy is ~12,000 Mw(t). (auth)

48937 SPACE, TIME, AND ENERGY DISTRIBUTIONS OF NEUTRONS AND X RAYS FROM A FOCUSED PLASMA DISCHARGE. Bernstein, M. J.; Meskan, D. A.; van Paassen, H. L. L. (Aerospace Corp., Los Angeles, Calif.). Phys. Fluids, 12: 2193-2202(Oct. 1969).

The energy spectrum and spatial distribution of neutrons emitted by a plasma focus device were measured with nuclear emulsions and scintillation detectors, and the results are reported. The average energy of the D–D neutrons emitted along the axis was shifted ~500 keV corresponding to an axial center-of-mass velocity of 2×10^8 cm/sec for the reacting deuterons. An 11% anisotropy in the neutron fluxes measured in the forward and radial directions correlates with an axially streaming plasma which is not isotropic; the reacting deuterons collide predominantly in the radial direction. Time-resolved collimation measurements of the emitted neutrons showed an axial translation of the neutron source corresponding to velocities up to 2×10^8 cm/sec; this correlates with the nonsimultaneous pinching of the noncylindrical plasma along the axis. Plasma densities of $\sim 2 \times 10^{19}$ cm^{-3} and ion temperatures of 2 keV were consistent with observed neutron yields of 10^{10} and pulse widths of 60 nsec. X-ray intensity measurements were made for x-ray energies of $7 < E_p < 30$ keV and showed an E_p^{-2} dependence which does not agree with plasma bremsstrahlung, but appears to result from anode bombardment of axially accelerated electrons with energies >200 keV. The line radiation corresponded to that of fairly cold ions. (auth)

48938 LEVITATION OF CURRENT CARRYING HOOPS OF QUADRUPOLE MAGNETIC FIELD FOR THERMONUCLEAR FUSION DEVICE. Kawashima, Nobuki; Mori, Sigeru (Japan Atomic Energy Research Inst., Ibaraki). J. Nucl. Sci. Technol. (Tokyo), 6: 526-30(Sept. 1969).

A simple and reliable method of levitating current-carrying hoops of a quadrupole magnetic field for thermonuclear fusion devices is presented. The hoops are initially posed on three supports, which are then propelled downward by repulsive force generated in a magnetic coil fed from a capacitor bank, leaving the current-carrying hoops gravitating in space for more than 10 msec. The reproducibility is perfect and no damage nor deformation has been sustained by the components even after repeated use. Some preliminary experiments on plasma injection with this device are described. A suggestion is also presented on another possible method of levitation which should permit weightless suspension in space for longer periods as required in thermonuclear reactors. (auth)

48939 CREATION AND INVESTIGATION OF HIGH-SHEAR MAGNETIC SURFACES ON URAGAN STELLARATOR. Aleksin, V. F.; Biryukov, O. V.; Georgievskii, A. V.; Grot, Yu. I.; Ziser, V. E.; Kitaevskii, L. Kh.; Pogozhev, D. P.; Sergeev, Yu. F.; Suprunenko, V. A.; Tolok, V. T. At. Energ. (USSR), 27: 240-3 (Sept. 1969). (In Russian).

A longitudinal magnetic field with up to 10 kOe intensity was created by current flow over 30 coils distributed evenly at 345 mm along the axis of the installation with the radius of R = 1100 mm, vacuum chamber radius r = 100 mm, rectilinear zone length 1725 mm, and total length L_0 = 10.35 m. Magnetic field studies were made using the method of single-cycle and multicycle passage of low-energy electron beams along the installation. Considerable influence of the distribution of cylindrilizers on the helical winding and on the configuration of magnetic surfaces was observed. The parameters of magnetic surfaces obtained by multicycle measurements are presented in graphical form. It is shown that the maximum of measured magnitude $i_0 \approx 230°$ (where i_0 is the angle of transformation of power lines along the length of the installation) for the radius $r_0 \approx 60$ mm, at $E \approx 0.65$, corresponds to the shear $S \approx 0.09$. (R.V.J.)

48940 SOME NEW CONSIDERATIONS CONCERNING AN ACCELERATED SUPERCONDUCTING SOLENOID. Baum, P. J. (Univ. of California, Riverside). J. Appl. Phys., 40: 4059-61(Sept. 1969).

An idea by Winterberg to accelerate a superconducting solenoid to hypervelocities in a magnetic traveling-wave accelerator is examined in more detail. Approximate calculations are done to determine the relative importance of diamagnetic effects as compared to fixed magnetic moment effects due to a presistent current in a type II superconductor. It is concluded that fixed magnetic moment effects predominate at very high magnetic field gradients. For the particular configuration considered the accelerator length must be increased about 5% or 3% depending on whether the diamagnetic and fixed magnetic moments are parallel or anti-parallel, respectively. (auth)

Wave Phenomena

48941 (AD-689828) THEORY OF ELECTROMAGNETIC WAVE PROPAGATION IN A HOT MAGNETOPLASMA. Physical Sciences Research Papers No. 380. Papa, Robert J. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.). May 1969. 71p. (AFCRL-69-193). CFSTI.

A brief discussion is given of the physical processes that occur in a hot magnetoplasma, and the results are compared to a cold plasma model. The conventional linearization of the Boltzmann equation is discussed, where the electron distribution function is expanded in terms of a small parameter proportional to the externally imposed electric field. Particle collisions are described by a relaxation model for the electron–neutral collision integral. The plasma is assumed to be Lorentzian, so that Coulomb collisions and ion motion are both neglected. Explicit expressions for the components of the conductivity tensor are given in Cartesian coordinates and in the principal coordinate system in which the conductivity tensor is symmetric. By asymptotically expanding the components of the conductivity tensor, it is shown how the dispersion relation determining the index of refraction becomes a relatively simple cubic equation. The Clemmow–Mullaly–Allis diagram is discussed for a warm plasma. Finally, the derivation of the radiation resistance of a short antenna in a hot, isotropic plasma is carried out in detail. (auth) (USGRDR)

48942 (AD-690537) STUDIES IN ELECTROMAGNETIC MODES AND WAVE–PLASMA INTERACTIONS. Final Scientific Report No. 7, March 1966–December 1968. Schlesinger, S. Perry; Marshall, Thomas C. (Columbia Univ., New York. Dept. of Electrical Engineering). Apr. 1969. Contract AF-19(628)-5832. 48p. (AFCRL-69-197). CFSTI.

The following topics are discussed: perturbation theories for gross nonuniform and random electromagnetic structures; zeros of analytic functions; plasma microinstabilities in crossed fields; wave mixing in a bounded magnetoplasma; improper surface waves; correlation radiometry; and nonlinear optics with finite geometry. (auth) (USGRDR)

48943 (CEA-R-3862) INSTABILITIES AND GROWING WAVES: POWER ABSORBED OR GENERATED BY THE VARIOUS EXCITED MODES IN A PLASMA. Rolland, Paul (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Aug. 1969. 111p. (In French). Dep. CFSTI (U. S. Sales Only).

Thesis. Submitted to Paris Univ., Orsay, France.

The character, stable or unstable, of a medium can be deduced from the behavior of an ideal model of a semi-infinite medium subjected to an excitation only at the boundary. A new analytic method is used to solve this problem. The results obtained show a relation between the character of the medium and certain properties of the dispersion equation, and agree with those derived from other methods. Then, the energy exchange between a medium and a source of excitation is investigated. In order to include the case of growing waves associated with convective instabilities, this problem is treated in the context of the wave-packet theory. One finds that, even in the absence of collisions, there still is a power exchange. Thus a relation can be established between the kinematic theories of growing waves, and the modes generating power can be found. Moreover, the power absorbed by spatial dispersion is found to be identical with that due to Landau's effect for long waves. This confirms the kinematic character of the latter and bridges a gap between macroscopic and microscopic theories. (auth)

48944 (COO-1695-24) PLASMA INSTABILITIES AND WAVES EXCITED BY AN ANISOTROPIC ENERGY DISTRIBUTION PRODUCED BY ELECTRON CYCLOTRON RESONANCE. Quarterly Progress Report No. 10. Shohet, J. L. (Wisconsin Univ., Madison. Dept. of Electrical Engineering). Sept. 15, 1969. Contract AT(11-1)-1695. 20p. Dep. CFSTI.

The purpose of this research is to investigate the ability of a short pulse of electron cyclotron resonance radiation to produce an anisotropic energy distribution of electrons in a plasma, and the instabilities and waves produced by this anisotropy. In particular, the nature of the rf heating mechanism and the behavior of the radiation emitted from the plasma are considered. The electron cyclotron resonance device was operated both in a short rapidly repeating mode, and a long (up to 1 millisecond) mode to obtain measurements of free–free bremsstrahlung, wall bremsstrahlung, plasma diamagnetism, energetic electron flux, and electron density in the discharge. Theoretical work on developing an expression for the free–free bremsstrahlung from a plasma containing an anisotropic electron energy distribution was continued. The two areas of interest currently under investigation are: (1) to write an energy distribution function for electrons in a plasma when the energy distribution of electrons is anisotropic and some of the electrons have relativistic velocities; (2) using this energy distribution function, calculate the free–free bremsstrahlung emission pattern from the plasma. The plasma simulation work continued with computations for the conditions of electron cyclotron resonance, periodic boundary conditions, rf confinement (no magnetic field) and cold plasma (zero-temperature models). (auth)

48945 (RISO–190) PHASE MIXING AND SPATIAL LANDAU DAMPING OF ION-ACOUSTIC WAVES. Nielsen, Per (Danish Atomic Energy Commission, Risoe. Research Establishment). July 1969. 35p. Dep. CFSTI (U. S. Sales Only).

Experiments on the interaction between a biased grid and the upstream plasma of a single-ended Q-machine are described. It is found that the grid reflects some of the ions in the plasma flow. When exciting waves under these conditions, one finds a phase velocity much higher than expected for the "natural mode" of Landau's dispersion relation. The results may be explained by assuming the ions of the initial perturbation to be freely streaming. The Green function for ion-acoustic waves is calculated with different distribution functions. The results are compared with the results for freely streaming particles. One finds that an assumption of freely streaming particles is justified in the experiments described. In more general situations for the downstream plasma and in double-ended operation, one no longer has free streaming, but the shape of the Green function is always dependent on the distribution of the initial perturbation. (auth) (Denmark)

48946 AMPLIFICATION OF THE FUNDAMENTAL PLASMA MODE THROUGH NONLINEARITY. Lal, P. (Univ. of Liverpool). Phys. Lett., 29A: 713-14(Aug. 25, 1969).

The instability of plasma oscillations in the presence of an external surge is described through a self-consistent nonlinear solution. (auth)

48947 PERTURBATION METHOD FOR A NONLINEAR WAVE MODULATION. I. Tanuti, Tosiya (Nagoya Univ., Japan); Yajima, Nobuo. J. Math. Phys. (N.Y.), 10: 1369-72(Aug. 1969).

A system of nonlinear wave equations which admits, in a linear approximation, a planewave solution with high-frequency oscillation is considered. Then, for the wave of small but finite amplitude, one investigates how slowly varying parts of the wave such as the amplitude are modulated by nonlinear self-interactions. A stretching transformation shows that, in the lowest order of an asymptotic expansion, the original system of equations can be reduced to a tractable, single, nonlinear equation to determine the amplitude modulation. (auth)

48948 COMPRESSION WAVE WITH FINITE AMPLITUDE IN A MAGNETIZED PLASMA. Zickert, D. W.; Schneider, H. (Univ., Freiburg i. B.). Helv. Phys. Acta, 42: 871-88(1969). (In German).

A hydromagnetic compressional wave with finite amplitude is excited in a homogeneous argon plasma of cylindrical geometry. The propagation of this wave along a quasi-static axial magnetic field and the increase of plasma conductivity are studied, when the perturbation ratio is increased up to $B_z/B_0 = 0.35$. The experiment verifies the influence of higher harmonics as postulated by the nonlinear theory of L. C. Woods. (auth)

48949 NONLINEAR INTERACTION OF SURFACE WAVES. Kondratenko, A. N.; Shaptala, V. G. (Inst. of Physics and Tech., Kharkov). Ukr. Fiz. Zh., 14: 1092-9(July 1969). (In Russian).

A nonlinear interaction of surface waves (of both low and high frequencies) is considered in a nonisothermal semibounded plasma. Using a sharp plasma–vacuum boundary model, nonuniform boundary conditions are obtained for the fields. This nonuniformity is due to a nonlinear surface current. Coupling coefficients and excitation increment are found for two cases. In one case, the contribution from the surface current to the increment is of the same order as that from the volume terms, in the other case the surface current becomes predominant. (auth)

48950 KORTEWEG–DE VRIES EQUATIONS FOR NONLINEAR HYDROMAGNETIC WAVES IN A WARM COLLISION-FREE PLASMA. Kever, H. (Kernforschungsanlage, Juelich, Ger.); Morikawa, G. K. Phys. Fluids, 12: 2090-3(Oct. 1969).

As has been shown previously for the case of a cold plasma, the structure and propagation of hydromagnetic waves of finite but small amplitude can be described by the Korteweg–de Vries equation. This equation can be derived from the set of the hydromagnetic equations for a collisionless cold plasma by applying certain scaling relations between the pertinent field variables. For a cold plasma, the hydromagnetic transport equations are equivalent to the Vlasov equations because the distribution functions of the particle velocities are delta functions. In the case of a warm plasma, the initial distribution functions are Maxwellian. Starting from the Vlasov equations for the electron and ion gas of the plasma, the procedure as applied in the case of a zero temperature plasma leads, under known conditions, to a generalized time-dependent Korteweg–de Vries equation, with coefficients depending on the temperature of either plasma component and on the angle between the direction of wave propagation and the initial magnetic field. Charge separation effects and displacement currents appear to be negligible to lowest order. (auth)

48951 NUMERICAL STUDY OF WEAKLY UNSTABLE ELECTRON PLASMA OSCILLATIONS. Armstrong, Thomas P. (Univ. of Kansas, Lawrence); Montgomery, David. Phys. Fluids, 12: 2094-8(Oct. 1969).

The initial-value problem for an unstable electron plasma has been solved by numerically integrating the Vlasov equation in one dimension. The situation chosen is the familiar "bump-on-the-tail" situation of quasi-linear theory. The solution is followed well beyond the point at which the electrostatic field energy has reached its maximum value. The electric field spectrum is eventually dominated by the single most linearly unstable wave number, which lies in the middle of the allowed range of wave numbers; it undergoes what appear to be the beginnings of gentle long-period oscillations characteristic of trapped-particle periodicities. It is argued that differences from quasi-linear predictions may be explained in terms of the level of initial excitations, or "noise," from which the instability is assumed to proceed. (auth)

48952 RESONANCES (TE_{0mn}, $TM_{1m\theta}$) OF A CYLINDRICAL CAVITY CONTAINING A NONUNIFORM PLASMA COLUMN. Blevin, H. A.; Reynolds, J. A. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). J. Appl. Phys., 40: 3899-3904(Sept. 1969).

Solutions of the wave equation are obtained for TE_{0mn} and $TM_{1m\theta}$ modes in cylindrical cavities containing a coaxial, annular plasma column. The radial electron density distribution is assumed to be of the form $n_e = n_0 [1 - \gamma_1(r/a)^2 - \gamma_2(a/r)^2]$, where n_0, γ_1, and γ_2 are constants and a is the outer radius of the plasma. The results can be used to determine the effects of density gradients on measurements of electron densities and collision frequencies by the cavity method. Some illustrative examples are presented. (auth)

48953 MICROWAVE TRANSMISSION THROUGH A MAGNETOPLASMA SLAB NEAR THE PLASMA CUTOFFS. Tetenbaum, S. J. (Lockheed Palo Alto Research Lab., Calif.). J. Appl. Phys., 40: 3915-18(Sept. 1969).

The extraordinary wave transmission through the afterglow of an rf-excited, electrodeless, helium discharge was investigated experimentally. The discharge approximates a low-collision-frequency plasma slab of relatively uniform electron density in a uniform magnetic field. Measurements were performed at 18.0 and 9.15 GHz. A transmission minimum occurs very close to the higher-frequency cutoff and a large decrease in transmission occurs close to the lower-frequency cutoff. The plasma cutoff positions are approximately independent of energy in the electron energy range from thermal energy to a few electron volts and of pressure in the range from 0.08 to 2.5 torr. The position of the transmission minimum coincides with the position of the emission peak previously observed. (auth)

Shielding

Refer also to abstracts 47679, 48357, 49074, and 49242.

48954 (GESP–295) PROGRAM LCDUCT: TWO-BEND RECTANGULAR DUCT RADIATION LEAKAGE ANALYSIS. Edwards, W. E.; Henderson, W. B. (General Electric Co., Cincinnati, Ohio. Nuclear Systems Programs). [1968]. 48p. Dep. CFSTI.

Program LCDUCT was coded in General Electric MARK II time-sharing FORTRAN for analysis of fast neutron and gamma-ray scattering through Z-shaped, two-bend, rectangular concrete ducts. Dose rates are computed for axial positions at each bend and at the exit for a surface source on the entrance plane normal to the duct axis. The program applies differential dose albedos in a modification and extension of the numerical technique developed by LeDoux and Chilton. Calculated gamma dose rates are consistently 25 to 35% below measured values. Although calculated neutron dose rates are less consistent, they are generally within ±50% of measured data. (auth)

48955 (N–69–31986) HELICAL DUCT GEOMETRY ROUTINE FOR THE SHIELDING COMPUTER PROGRAM "FASTER." Jordon, Thomas M.; Wohl, Millard L. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Aug. 1969. 20p. (NASA-TM-X–1838). CFSTI.

A method for tracking neutrons through a slab penetrated by a helical voided duct is presented and verified. The FORTRAN listings of computer subroutines that perform the numerical analysis are included: these subroutines are designed to be used with FASTER, a high-efficiency Monte Carlo code. Neutron number spectra were calculated at several points in and near the emergent end of a duct through a 20- and a 100-cm thick water slab having a point source at the center of the inlet. (auth) (STAR)

48956 (N–69–32341) FAST NEUTRON SHIELDING STUDIES. Wilensky, Samuel; Beghian, Leon E.; Clikemann, Franklin (Mas-

sachusetts Inst. of Tech., Cambridge. Dept. of Nuclear Engineering). June 30, 1969. 37p. (NASA-CR-103597; MIT-NE-101). CFSTI.

A neutron spectroscopy technique used to study the shielding properties of iron–paraffin assemblies is described. The spectrometer was also used to measure time-dependent neutron spectra from an iron assembly after excitation by a pulse of monoenergetic neutrons. (auth) (STAR)

48957 (ORNL-TM-2587) GROUND HEATING DUE TO A POINT SOURCE OF 12.2- TO 15-MeV NEUTRONS AT AN ALTITUDE OF 50 FEET. Straker, E. A.; Emmett, M. B.; Thompson, C. L. (Oak Ridge National Lab., Tenn.). Aug. 19, 1969. 25p. Dep. CFSTI.

Heat deposited in the ground as a function of range, ground depth, and time due to the neutrons and their secondary gamma rays from a 12.2- to 15-MeV neutron source was determined. The source was situated at an altitude of 50 feet above the ground in air of uniform density (1.10 gm/l). Both Monte Carlo and discrete ordinates methods were used to transport the neutrons and gamma rays through the atmosphere and into the ground. The importance of low-energy neutrons and the secondary gamma rays to the total heat deposited is shown. (auth)

48958 (RRA-M-71-A(Rev.)) SIMPLIFIED METHOD FOR CALCULATING NITROGEN-CAPTURE AND FISSION-PRODUCT GAMMA-RAY DOSES INSIDE UNDERGROUND CONCRETE STRUCTURES. Marshall, J. D.; Wells, M. B. (Radiation Research Associates, Inc., Fort Worth, Tex.). June 11, 1967; Revised Apr. 21, 1969. Subcontract 2329. 31p. (CONF-670602-32). Dep. CFSTI.

From 13th Annual Meeting of the American Nuclear Society, San Diego, Calif.

For Oak Ridge National Lab., Tenn.

A simplified method was developed to calculate the gamma dose, at a detector position on the centerline of underground cylindrical structures, that results from the fission-product and nitrogen-capture gamma rays produced by a nuclear weapon detonation. Application of the method requires knowledge only of the structure geometry and the fission-product and capture gamma-ray doses incident on the concrete cover shield of the underground structure. To provide the dose transmission data used in the calculational method, a series of S_n problems were run for isotropic and anisotropic fission-product and nitrogen-capture gamma rays incident on concrete slabs for thicknesses up to 60 inches. The gamma-ray dose at a detector on the centerline of the structure is calculated from the product of the outside dose, the transmission factor, and the fraction of the transmitted dose which reaches the detector. Functions defining the fraction of the transmitted dose reaching a detector positioned on the centerline of an underground cylindrical structure were derived for both the isotropic and anisotropic fission-product and nitrogen-capture gamma-ray source terms. (auth)

48959 PROKHOZHDENIE IZLUCHENII CHEREZ NEODNORODNOSTI V ZASHCHITE. (Radiation Penetration Through Non-Homogeneities in Shielding). Leipunskogo, O. I. (ed.). Moscow, Atomizdat, 1968. 336p.

Classifications of shielding heterogeneities, information concerning shielding constants, and methods for estimation and experimental study of radiation fields in shielding with heterogeneities are considered. The passage of radiations through the basic groups of the most often encountered heterogeneities, straight lines either hollow or filled, channels completely or partially penetrating the shielding, multisectioned bent channels, monoaxial and multiaxial stepwise channels, and shielding with spaces or impurities distributed in it, was studied. The perturbation introduced in the radiation field distribution by straight heterogeneities was evaluated. For solution of the problems, the general approach was the division of the characteristics of the radiation field (beam density, intensity, dose rate, etc.) into separate components. (tr-auth)

48960 PENETRATION OF NONHOMOGENEITIES IN SHIELDING BY RADIATION. Zolotukhin, V. G. Moscow, Atomizdat, 1968. 335p. (In Russian).

The basic definitions and classification of nonhomogeneities encountered in a shield, basic information on the shielding constants for purposes of calculations, methods of calculating, and experimental studies of radiation in shielding with nonhomogeneities are covered. The penetration of the more frequently encountered nonhomogeneities by radiation is considered in detail: straight hollow or filled, with complete or partial penetration of the duct shielding; through curved multisectional ducts; through monoaxial and multiaxial stepped ducts in the shielding; through shielding with empty spaces or impurities distributed throughout it. The effect of straight nonhomogeneities on the dissemination of the radiation in the medium is evaluated. The general approach in the solution of problems is to break down the characteristics of the radiation field (current density, intensity, dosage, etc.) into their component parts. (JPRS)

Solid-State Physics

Refer also to abstracts 47423 and 49470.

48961 SOLID-STATE PHYSICS. Blakemore, J. S. Saunders Physics Books. Philadelphia, W. B. Saunders Company, 1969. 400p. $13.50.

This book is intended as the text for a one-semester course at the level of the senior undergraduate year. The five chapters are labeled: Crystallinity and the Form of Solids, Lattice Dynamics, Electrons in Metals, Semiconductors, and Dielectric and Magnetic Properties of Solids. (D.L.C.)

48962 DYNAMIC ORIENTATION OF SPIN 1 NUCLEI. III. Midha, J. M.; Gupta, S. K.; Narchal, M. L. (Punjabi Univ., Patiala, India). Appl. Opt., 8: 1732-3(Aug. 1969).

Tables are presented for nuclear polarization of spin 1 nuclei with various approximations of nuclear spin–lattice relaxation. The nuclear relaxations: (1) reduce the polarization on the average by about 33% in the range $\Delta < 1000$; (2) do not much affect the alignment to a great degree, signal power, enhancement in the high temperature limit; (3) reduce the alignment by about 15% in the low-temperature limit; (4) reduce the enhancement to about 25 to 33% of its value in the low-temperature limit; (5) increase the Jeffries–Abragham enhancement with nuclear Zeeman interaction dominating, to above three times its value in the absence of nuclear relaxations; and (6) reduce the signal power by about 50% in the low-temperature limit. (J.W.R.)

Radiation Effects

Refer also to abstract 47913.

48963 (IAE-1649) THE EFFECT OF REACTOR γ EMISSION ON THE RADIATION ANNEALING OF DEFECTS. Karpukhin, V. I.; Chugunov, O. K. (Akademiya Nauk SSSR, Moscow. Institut Atomnoi Energii). 1968. 38p. (In Russian). Dep. CFSTI (U.S. Sales Only).

Experimental data are presented that indicate an increase in the effectiveness of radiation annealing of defects when the temperature of irradiation is elevated. This result is caused mainly by reactor gamma radiation. A qualitative calculation is given for the rate of formation of defects due to neutron and gamma radiation. Also presented are the results of calculation of the flux of Compton electrons producing an internal bombardment of the substance in an MR-2 reactor. (auth)

48964 ATOMIC INTERACTION POTENTIAL. Wedepohl, P. T. (Univ. of Witwatersrand, Johannesburg). Radiat. Eff., 1: 77-83(Apr. 1969).

A knowledge of the interaction energy between two atoms as a function of their separation is important in many aspects of radiation damage theory. Recent calculations of this energy from first principles are reviewed, particular attention being paid to calculations based on the Thomas–Fermi and Thomas–Fermi–Dirac statistical theories of the atom. The advantages and limitations of these theories are discussed from the radiation damage point of view. The energy ranges over which experimental results or theoretical calculations are more useful at present are also discussed. (auth)

48965 SIMULTANEOUS DEFECT PRODUCTION AND DIFFUSION-LIMITED RECOVERY. Corbett, J. W. (General Electric Research and Development Center, Schenectady, N. Y. State Univ. of New York, Albany). Radiat. Eff., 1: 85-8(Apr. 1969).

It is shown that a recently introduced, computational technique makes possible, for the first time, the theoretical treatment of the simultaneous production of reacting species and their diffusion-limited reactions. The approach is illustrated with radiation-damage examples, but the technique should be applicable, as well, to problems in photo- and radiation chemistry, in luminescence, and in precipitation-type reactions. (auth)

48966 DEEP MULTISTREAM DIFFUSION IN ION IMPLANTATION. Sparks, M. (North American Rockwell Corp., Thousand Oaks, Calif.). Phys. Rev., 184: 416-25(Aug. 10, 1969).

Very deep penetration of ions injected into crystals has been reported in several recent experiments. These "supertails," which extend deeper into the crystals than the normal stopping range or channeling range, have the form $n_i \sim (x - x_0)^{-n}$, where n_i is the number of incident ions per cm^2, x is the distance from

the surface of the crystal, η is typically ~2–8, and x_0 is ~1 μ or less. Multistream steady-state-diffusion models are developed to explain these supertails. The results agree well with published experimental data. Multistream diffusion may also be involved in other experiments, such as radiation-enhanced diffusion experiments and implantation experiments in which channeling is suppressed, but the measured concentration profiles are within the maximum channeling range. (auth)

48967 GAMMA-IRRADIATION EFFECTS IN SINGLE-CRYSTALLINE BARIUM TITANATE. Keating, John J.; Murphy, Glenn (Iowa State Univ. of Science and Tech., Ames). Phys. Rev., 184: 476-80(Aug. 10, 1969).

Results are presented of an experimental investigation of ^{60}Co γ-irradiation effects in single-crystalline barium titanate. Two test groups of crystals were utilized in this study. Prior to being irradiated, one group was etched in phosphoric acid at 145°C to remove a surface layer having properties which differ from the bulk of the crystal. The second group of crystals was irradiated in the as-grown condition. Following irradiation at various γ doses, the ferroelectric hysteresis loop was determined, measurements were taken of the optical absorption spectrum in the wavelength range 0.43–0.70 μ, and photomicrographs of the domain structure were obtained. The temperature was maintained at 20°C during irradiation, and all post-irradiation measurements were made at 23°C. The etched crystals were irradiated in the poled condition to a maximum dose of 1.60×10^9 rad. The remanent polarization P_r was unaffected by a total γ dose of about 2×10^8 rad. Irradiation to higher dose levels caused a reduction in P_r. The coercive field E_c was reduced with initial irradiation. At a dose of about 5×10^8 rad, a minimum value was reached and E_c then increased with continued irradiation. The domain structure of the c-domain crystals was unaffected by a total γ dose of 1.60×10^9 rad. No absorption peaks were observed in the wavelength range studied as a result of γ irradiation. The radiation-induced changes observed in the ferroelectric hysteresis loop of etched crystals cannot be attributed to changes in the domain structure or to the presence of point defects consisting of an oxygen vacancy with a single trapped electron. The unetched crystals were irradiated to a maximum dose of 2.91×10^8 rad. With initial irradiation, the polarization reversal process was enhanced as the remanent polarization increased and the coercive field decreased. With increasing dose above 2×10^7 rad, the hysteresis loop gradually deteriorated. The unetched crystals were found to be much more sensitive to γ radiation than were the etched crystals. (auth)

48968 SPATIAL AND ENERGY DISTRIBUTIONS OF IONS SCATTERED BY CRYSTAL. Mashkova, E. S.; Molchanov, V. A.; Skripka, Yu. G. (Moscow State Univ.). Phys. Lett., 29A: 645-6(Aug. 25, 1969).

A sharp anisotropy of spatial and energy distributions of 30-keV argon ions scattered by a copper crystal was observed. The results seem to indicate that the observed regularities are caused, not by closest-packed atomic rows properly, but rather by surface half-channels formed by these rows. (M.H.R.)

48969 POINT-DEFECT RECOVERY IN NEUTRON-IRRADIATED TUNGSTEN AT 0.31 T_m. Keys, L. K.; Moteff, J. (General Electric Co., Cincinnati). Contract AT(40-1)-2847. Phys. Lett., 29A: 706-7(Aug. 25, 1969).

The results of some resistivity studies of the recovery of defects in neutron-irradiated tungsten provide additional evidence for the recovery of monovacancies at 0.31 T_m. (auth)

48970 THE STOPPING POWER OF PROTONS CHANNELLED THROUGH CsI CRYSTALS. Clark, G. J.; Dearnaley, G.; Morgan, D. V.; Poate, J. M. (Atomic Energy Research Establishment, Harwell, Eng.). Phys. Lett., 30A: 11-12(Sept. 8, 1969).

The stopping power of 4-MeV protons channelled along a ⟨1 1 1⟩ direction through a CsI crystal has been measured. The result is compared with theory. (auth)

48971 INTERACTION OF A BEAM OF CHARGED PARTICLES WITH COUPLED SPIN AND PLASMA WAVES. Lominadze, D. G.; Savchenko, M. A.; Stepanov, K. N. Sov. Phys.-Solid State (Engl. Transl.), 11: 589-92(Sept. 1969).

Translated from Fiz. Tverd. Tela, 11: 739-43(Mar. 1969).

Expressions are obtained for the growth rates of coupled spin–plasma waves in magnetically ordered semiconductors and metals, excited by a nonrelativistic compensated "cold" electron beam and by a beam of oscillators: electrons with identical Larmor radius and equiprobable values of the phase on the Larmor orbit. (auth)

48972 MODEL FOR THERMAL MOTION DURING RADIATION DAMAGE IN CRYSTALS. Agranovich, V. M.; Kirsanov, V. V. Sov. Phys.-Solid State (Engl. Transl.), 11: 540-4(Sept. 1969).

Translated from Fiz. Tverd. Tela, 11: 674-9(Mar. 1969).

It is shown how the model for radiation damage developed by Vineyard et al., can be generalized so that it encompasses the dynamics of radiation damage in crystals taking thermal motion of the atoms into account. Using this method, the propagation of chains of interatomic collisions in the ⟨100⟩ directions of a bcc lattice is treated, taking into account the zero-point vibrations of the atoms, and a comparison is made between these results and earlier ones, in which thermal motion was not considered. (auth)

48973 MATHEMATICAL SIMULATION OF RADIATION DAMAGE IN CRYSTALS WITH fcc AND bcc LATTICES. Klimenkov, V. I.; Kirsanov, V. V.; Osipova, Z. Ya. Sov. Phys.-Cryst. (Engl. Transl.), 13: 922-4(May-June 1969).

Translated from Kristallografiya, 13: 1060-3(May-June 1969).

Crystals with fcc and bcc lattices were simulated by Vineyard's method. Programs were set up for the electronic computer BESM-3M. In a crystal with a fcc lattice, the dynamical problem of the development of a displacement cascade was solved. In a crystal with bcc lattice, the configuration of a complex defect consisting of two interstitial atoms was investigated. A stable configuration of the complex, possessing a positive binding energy, was obtained. (auth)

48974 THE MEASUREMENT OF ELECTRICAL ACTIVITY AND HALL MOBILITY OF BORON AND PHOSPHORUS ION-IMPLANTED LAYERS IN SILICON. Webber, R. F.; Thorn, R. S.; Large, L. N. (Services Electronics Research Lab., Baldock, Eng.). Int. J. Electron., 26: 163-72(Feb. 1969).

An investigation into the electrical behaviour of shallow implantations of boron and phosphorus in silicon is described. The clover-leaf Van der Pauw patterns were defined by planar masking techniques, and were ion implanted to produce a "tailored" impurity profile of approximately uniform concentration with depth. It was found that phosphorus implantations became fully electrically active after annealing at a temperature between 620°C and 750°C, whereas the boron implantations required an anneal in excess of 900°C. A subsidiary activity peak, whose magnitude increased with the ion dose, was observed for the boron implantations after annealing at a temperature around 520°C. (auth) (UK)

48975 ULTRAVIOLET-INDUCED CHANGES IN RESIDUAL THERMOLUMINESCENCE FROM GAMMA-IRRADIATED LITHIUM FLUORIDE. Gower, Richard G.; Hendee, William R.; Ibbott, Geoffrey S. (Univ. of Colorado, Denver). Health Phys., 17: 607-11(Oct. 1969).

Exposing γ-irradiated LiF (TLD-100) to ultraviolet light after the dosimetric glow peak at 210°C has been recorded enhances the residual thermoluminescence measured during a second readout. The residual thermoluminescence exhibits a narrow peak centered at 200°C and a broad peak beginning at about 230°C. The area under the narrow peak increases with both the radiation dose and the exposure to ultraviolet. LiF measurements of high doses of radiation could possibly be confirmed by measuring residual thermoluminescence after exposing the phosphor to ultraviolet light. (auth) (UK)

48976 F- AND M-CENTER RADIATION GROWTH KINETICS IN NEEDLE-LIKE NaCl CRYSTALS OF VARIOUS ORIGIN. Gol'denberg, S. U.; Melik-Gaikazyan, I. Ya. (Kirov Polytechnic Inst., Tomsk, USSR). Sov. Phys.-Cryst. (Engl. Transl.), 13: 925-8 (May-June 1969).

Translated from Kristallografiya, 13: 1064-9(Nov.-Dec. 1968).

A detailed investigation of F- and M-center growth kinetics in needle-like (NL) NaCl crystals of various origin and diameter is first given. It is shown that the color center growth rate depends on the geometrical dimensions of the specimen ("scale factor") only for F centers and only for specimens grown from solution and "cleavage whiskers." The major differences in the properties of NL NaCl grown from the liquid and gaseous phases are discussed. The results are explained by supposing the existence of two F-center sources in the specimens in question. Some suggestions are made about the nature of these sources. (auth)

48977 DEPENDENCE OF SPIN-WAVE RESONANCE IN THIN FILMS ON IRRADIATION. Bailey, G. C. (Naval Research Lab., Washington, D. C.). Phys. Lett., 30A: 58-9(Sept. 8, 1969).

Parallel and perpendicular resonance field and intensity changes are discussed for a film (2200 Å thick, 75% Ni–25% Fe) subjected to $^3He^+$ particle irradiation. Most of the changes can be attributed to stress and inhomogeneity changes in the film. (auth)

48978 FORMATION OF VACANCY CLUSTERS BY THE DECHANNELING OF CHANNELED keV GOLD IONS IN GOLD. Schober, T.; Balluffi, R. W. (Cornell Univ., Ithaca, N. Y.). Can. J. Phys., 47: 1221-9(June 1, 1969).

Thin silver–gold single-crystal sandwich specimens consisting of a silver layer 700 ± 50 Å thick and a gold layer 850 ± 50 Å thick were bombarded along [001] at normal incidence to the silver

layer with 40-keV gold ions at room temperature. A significant number of the gold ions became channeled along [001] and were able to reach the gold layer where they produced radiation damage in the form of "black-spot" defects visible by transmission electron microscopy. (The silver layer therefore acted as a filter which allowed only channeled gold ions to enter the gold layer.) A stereo analysis of black–white contrast from the defects in the gold layer revealed that they were all vacancy type. Further measurements and observations indicated that the vacancy defects were formed in situ at displacement cascades initiated by the dechanneling of the channeled gold ions at thermally displaced atoms. It is concluded that the stopping of channeled gold ions in gold at room temperature by dechanneling at thermally displaced atoms is a major stopping mechanism in the energy range where nuclear stopping becomes important. (auth)

48979 ESR OF RADIATION DAMAGE IN INORGANIC SOLIDS. Symons, M. C. R. (Univ. of Leicester, Eng.). Advan. Chem. Ser., No. 82, 1-24(1968).

From Conference on Radiation Chemistry, Argonne, Ill. See CONF-680806-(Vol.2).

The way in which electron spin resonance can be applied to the problem of identification of species formed on exposure of inorganic materials to high-energy radiation is outlined. Recent results for a wide range of inorganic radicals formed in this way are collated and discussed. Radicals are classified as σ or π depending upon their electronic structure, and the problem of spin-polarization in π-radicals is discussed in some depth. Among the more recently discovered radicals mentioned are SH, S_2^-, Se_2^-, PH_2, CS_2^-, FOO, ClOO, BH_3^-, CO_3^{3-}, $C_2H_3^-$, and $S_2N_2^+$. The structure of a center originally described as F^{2-} formed in beryllium oxide is discussed in terms of the unit Be_2F^{2+}. Assignments are viewed critically, and in some instances alternative identifications are offered. (auth)

48980 CATHODE PULVERIZATION OF MONOCRYSTALS OF COPPER, SILVER, AND TUNGSTEN AT NEAR-THRESHOLD ENERGIES OF IONS. Tishchenko, V. D. (Kiev State Univ.). Radiotekh. Elektron., 13: 1642-6(Sept. 1968). (In Russian).

The minimum energies of ions at which the noticeable yield of cathode sputtering of monocrystals of Cu, Ag, and W begins was measured. Values obtained are compared with thresholds of sputtering calculated according to Harrison theory for these materials. As a result of the comparison, conclusions were made concerning the applicability of focused collisions to the threshold interactions of ions with the crystal structure. (tr-auth)

48981 STUDIES OF SUBSTRUCTURE OF NEUTRON-IRRADIATED AND ANNEALED TUNGSTEN AND MOLYBDENUM. Kravchenko, V. S.; Larikov, L. N.; Plotnikova, N. P. (Inst. of Metal Physics, Kiev). Fiz. Metal. Metalloved., 28: 185-7 (July 1969). (In Russian).

Data obtained on substructure and microhardness of W and Mo monocrystals irradiated by 5×10^{19} n/cm^2 and annealed at 800, 1000, 1200, and 1400°C for 30 min revealed an increased angular disorientation between subgrains (in radial direction) in W starting at 1000°C and Mo at 800°C. The observed increased disorientation was caused by expansion of the defects toward the subgrain boundaries and resulted from interactions between dislocation loops formed by neutron irradiation. (R.V.J.)

48982 X-RAY INDUCED CHANGES OF TRANSPORT PHENOMENA IN InSb. Kreutz, E. W. (Technische Univ., Darmstadt, Ger.). Z. Angew. Phys., 27: 244-51(July 14, 1969). (In German).

Changes of electrical transport properties and of thermal conductivity in n- and p-type InSb were measured under irradiation by x-rays at low temperatures. Annealing measurements of the x-ray-induced changes are presented and compared to the annealing measurements of the damage produced by electron irradiation. The measurements do not confirm the previous assumptions of a production of Frenkel pairs by an ionization process. The magnitude and the sign of the changes in electric conductivity can be influenced by various surface treatments. Field effect measurements show that for n- and p-type crystals the energy bands at the surface are bent by x-ray irradiation into the direction of higher hole concentration. (auth)

Physical Properties

Refer also to abstracts 48429, 48482, 48569, and 49296.

48983 (GA-9417) THERMAL EXPANSION AND PHONON FREQUENCY SHIFTS IN NON-PRIMITIVE LATTICES. Slaggie, E. Leo (Gulf General Atomic, Inc., San Diego, Calif.). [1969]. Contract AT(04-3)-167. 56p. Dep. CFSTI.

Expressions were derived in the quasi-harmonic approximation for the change in normal mode frequencies associated with thermal expansion in a nonprimitive lattice. The work is formulated in terms of coupling parameters for an undistorted lattice with cubic anharmonicity. Symmetric finite strain parameters and appropriate internal strains are introduced in such a manner that the formulation exhibits explicitly the invariance of the crystal potential energy and normal mode frequencies to rigid body rotations. As a numerical application, the coefficient of linear expansion and the phonon frequency distributions at 300 and 800°K were calculated for zirconium hydride with a short-range central force model including third-nearest-neighbor forces. (auth)

48984 (NP-18018) SPECTRA OF INTERACTING ELECTRONS IN METALS. Lundqvist, Bengt I. (Chalmers Tekniska Hogskola, Goteborg (Sweden)). 1969. 12p. Dep. CFSTI (U. S. Sales Only).

A thesis, summarizing seven papers, is presented on the important effects of the strong Coulomb interaction in metals. The Green function method is used to analyze the self-energy, and spectral weight functions are studied. Electron–plasmon coupling and plasmarons are also studied. (D.L.C.)

48985 FERMI SURFACES OF BERYLLIUM AND OF DILUTE ALLOYS OF COPPER IN BERYLLIUM. Everett, Paul Marvin. Cleveland, Case Western Reserve Univ., 1968. 108p.

Thesis.

The de Haas–van Alphen (dHvA) effect has been used to study the Fermi surfaces in Be and in 0.4 and 0.08 at. % alloys of Cu in Be. The dHvA frequencies in Be have been measured in the three major crystallographic planes to better than 0.5% uncertainty and selected cyclotron masses to better than 3% uncertainty. These masses have been compared to the corresponding band structure cyclotron masses calculated from a nonlocal pseudopotential model that used the dHvA frequencies to fit the model parameters. This comparison showed that the mass enhancement was approximately 20% and was nearly isotropic over the Be Fermi surface. The calculated and experimental dHvA frequencies agree to within 1%. The dHvA frequencies observed in the alloys are similar to those in Be. The changes are in agreement with a simple rigid band approximation if it is assumed that Cu acts as a monovalent solute. (Diss. Abstr.)

48986 ELASTIC CONSTANTS AND ULTRASONIC ATTENUATION OF A β-TUNGSTEN-STRUCTURE V_3Ge CRYSTAL FROM 4.2 TO 300°K. Rosen, M. (Nuclear Research Center-Negev, Beer-Sheva, Israel); Klimker, H.; Weger, M. Phys. Rev., 184: 466-71(Aug. 10, 1969).

The longitudinal and transverse acoustic velocities and the ultrasonic attenuation of a β-tungsten V_3Ge crystal with the β-tungsten structure were measured by a pulse technique at a frequency of 10 MHz between 4.2 and 300°K. The room-temperature elastic moduli were determined as $C_{11} = 2.966$, $C_{44} = 0.6978$, and $C_{12} = 1.042$ in units of 10^{12} dyn/cm^2. Contrary to the behavior of the β-tungsten-structure compounds V_3Si and Nb_3Sn, the adiabatic compressibility of V_3Ge was found to be temperature-dependent. The elastic constant C_{11} exhibits a lattice-softening phenomenon in the temperature interval between 75 and 300°K. The shear modulus $\frac{1}{2}(C_{11}-C_{12})$ displays a minimum at 75°K. At this temperature the longitudinal (in contrast to the shear) attenuation shows a sharp peak. The behavior of the elastic moduli and attenuation are discussed in terms of possible operation of an electron transfer mechanism. In addition, both the longitudinal and the shear attenuation behave anomalously at 168°K. A relaxational process is assumed. The limiting value of the Debye temperature is found to be 487°K. At room temperature, it is 471°K. (auth)

48987 POSSIBLE OBSERVATION OF A COMPENSATED SPIN STATE IN THE ACTINIDE INTERMETALLIC COMPOUNDS $U_xTh_{1-x}Pd_3$. Davidov, D. (Hebrew Univ., Jerusalem); Lotem, H.; Shaltiel, D.; Weger, M.; Wernick, J. H. Phys. Rev., 184: 481-3 (Aug. 10, 1969).

An EPR measurement of Gd in $U_xTh_{1-x}Pd_3$, $0 < x < 1$, shows anomalous behavior as a function of temperature. These results, as well as previous anomalous susceptibility measurements of the same compounds, are taken to indicate the existence of a partially compensated spin state on the uranium in $U_xTh_{1-x}Pd_3$. This work indicates the possibility of the existence of the Kondo effect in concentrated spin systems. It shows also, that the utilization of the EPR technique is a powerful method for investigating the Kondo effect. (auth)

48988 MOLECULAR DYNAMICS AND STRUCTURE OF SOLIDS. 2nd Materials Research Symposium Held at the NBS, Gaithersburg, Maryland, October 16–19, 1967. Carter, R. S.; Rush, J. J. (eds.). Washington, D. C., National Bureau of Standards, 1969. 580p. GPO $4.00. (NBS-Spec. Publ.-301; CONF-671028).

A review is presented of the application of spectroscopic and diffraction techniques to the study of the structure and dynamics

of molecular solids. Invited papers on the theory and practice of the major experimental methods, including neutron and x-ray diffraction, neutron inelastic scattering, infrared and Raman spectroscopy and nuclear magnetic resonance, serve as a background for the more detailed presentation and discussion of results which follows. The topics covered in a series of invited and contributed papers include the lattice dynamics of molecular crystals, the spectroscopy and crystal structure of organic and inorganic solids and the dynamics of polymers. (auth)

48989 LOW-TEMPERATURE HEAT CAPACITY OF $CeAl_2$. Hill, R. W.; Machado da Silva, J. M. (Clarendon Lab., Oxford). Phys. Lett., 30A: 13-14(Sept. 8, 1969).

Heat capacity measurements of $CeAl_2$ show a λ anomaly at 3.4°K. (auth)

48990 THERMAL CONDUCTIVITY OF HOLMIUM AT LOW TEMPERATURES. Ratnalingam, R.; Sousa, J. B. (Clarendon Lab., Oxford). Phys. Lett., 30A: 8-9(Sept. 8, 1969).

The thermal conductivity of a single crystal and a polycrystal of holmium, measured between 0.8 and 4.2°K, can be separated into a linear (T) and a small quadratic (T^2) contribution. The Lorentz numbers, as estimated from the linear term by electrical resistivity measurements, are in reasonable agreement with the theoretical value. (auth)

48991 MAGNETIC SUSCEPTIBILITY OF NIOBIUM AND TANTALUM MONOCARBIDES AT LOW TEMPERATURES. Borukhovich, A. S.; Dubrovich, L. B.; Dubrovskaya, L. B.; Matveenko, I. I.; Gel'd, P. V. (Inst. of Chemistry, Sverdlovsk, USSR). Sov. Phys.-Solid State (Engl. Transl.), 11: 681-2 (Sept. 1969).

Translated from Fiz. Tverd. Tela, 11: 830-2(Mar. 1969).

The temperature dependence of the magnetic susceptibility χ of NbC_x ($x = 0.70$ to 0.98) and TaC_x ($x = 0.74$ to 0.97) was investigated at 20 to 300°K. The results show a minimum of χ for $NbC_{0.80}$ and $TaC_{0.78}$, and a change of the sign of the temperature coefficient $d\chi/dT$, in agreement with the model of the electron spectrum (in which χ is mainly due to the conduction electrons). The rapid variation of χ in the <30°K region is briefly discussed. (D.L.C.)

48992 THE EFFECT OF ULTRASOUND ON THE DISLOCATION STRUCTURE OF MOLYBDENUM SINGLE CRYSTALS. Polotskii, I. G.; Prokopenko, G. I.; Trefilov, V. I.; Firstov, S. A. (Inst. of Metal Physics, Kiev). Sov. Phys.-Solid State (Engl. Transl.), 11: 604-5(Sept. 1969).

Translated from Fiz. Tverd. Tela, 11: 755-7(Mar. 1969).

In Mo single crystals exposed to ultrasound (150 W/cm^2), the damping decrement undergoes a sharp increase owing to a rise in dislocation density, and it passes through a maximum at 15 min. The dislocation density, which is $<10^7$–10^8 cm^2 in annealed crystals, increases to 2.7×10^9/cm^2 after 15 min exposure, reaching 7×10^9/cm^2 after 1 hr exposure, comparable to that in 10%-deformed crystals. The temperature dependence of the ultrasound damping in the [110] direction was investigated, using a strength of 150 W/cm^2 for 15 min. The temperature of the damping maximum increases with frequency, from 360°K at 5 MHz. The activation energy of the relaxation maximum is calculated to be 0.38 eV for the [110] direction. (D.L.C.)

48993 INVESTIGATION OF TRANSVERSE MAGNETORESISTANCE OF THULIUM AT LOW TEMPERATURES. Nikol'skii, G. S.; Zvyagina, N. M. (Physical-Technical Inst. of Low Temperatures, Kharkov). Sov. Phys.-Solid State (Engl. Transl.), 11: 694-5(Sept. 1969).

Translated from Fiz. Tverd. Tela, 11: 842-4(Mar. 1969).

The transverse magnetoresistance of Tm was measured at 4.2 to 60°K in magnetic fields up to 22 KOe. In the ferromagnetic region (temperatures up to 35°K), the isotherms show the usual behavior: the field reduces the resistance initially at a high rate, followed by a weak field dependence. However, at 16 to 18 kOe, a new strong fall of the resistance is observed. The critical field required for breaking down the ferromagnetic 4 ↑ 3 ↓ spin structure was determined to be 16 kOe. (D.L.C.)

48994 PLASMA OSCILLATIONS IN CRYSTALLINE SOLIDS. Bakulin, E. A.; Balabanova, L. A.; Bredov, M. M.; Ostroumova, E. G.; Stepin, E. V.; Shcherbinina, V. V. (Ioffe Inst. of Physics and Tech., Leningrad). Sov. Phys.-Solid State (Engl. Transl.), 11: 549-52(Sept. 1969).

Translated from Fiz. Tverd. Tela, 11: 685-9(Mar. 1969).

Characteristic energy-loss spectra of 20-keV electrons passing through thin metal films having different crystal structures (hcp, fcc, bcc) were studied. It appears that the energy value of plasma oscillations (plasmons) in materials possessing an hcp structure has a significant (1 to 6 eV) positive shift relative to the theoretical value, $\hbar\omega_p$, calculated in the free-electron gas approximation for a metal. Effects are analyzed which may lead to a shift of the experimental value of the plasmon with respect to the theoretical value. A conclusion is drawn on the effect of anisotropy in the microscopic electron density on the position of plasmon lines in spectra of characteristic energy losses. (auth)

48995 ON THE CORRELATION OF MAGNETIC PROPERTIES AND CHEMICAL COMPOSITION OF COBALT–TUNGSTEN ELECTROLYTIC ALLOYS. Rachinskas, V. S. (Inst. of Chemistry and Chemical Tech., Vilnyus, USSR). Liet. TSR Mokslu Akad. Darbai, Ser. B, 1(56): 71-82(1969). (In Russian).

The effect of concentration, acidity, temperature, and current density of cobalt–tungsten electrolyte components on the chemical composition, magnetic properties of deposited Co–W alloys, and current efficiency of alloys was investigated. Cathode potential variations with current density, concentration of potassium tungstate in electrolyte, acidity of solutions, and temperature were measured. It was established that increasing the temperature of the electrolyte and diminishing the current density increases the tungsten percentage in the alloy and decreases magnetic flux density and coefficient of the hysteresis loop. In most cases, depending on working conditions and Co–W electrolyte component concentrations, the increase of the relative amount of tungsten in alloys increases the coercivity of Co–W alloys, decreases flux density, and deteriorates the hysteresis loop form. (auth)

48996 THE EFFECT OF CRYO-MAGNETIC TREATMENT ON MAGNETIC HYSTERESIS OF THE NIOBIUM–TIN SUPERCONTING ALLOYS. Zaikina, G. I.; Potapov, N. N. Sb. Tr. Tsent. Nauch.-Issled. Inst. Chern. Met., No. 63, 106-9(1968). (In Russian).

A study was made of the effects of cryo-magnetic treatment on the magnetic hysteresis of alloys of stoichiometric composition Nb_3Sn and compositions close to this. Such treatment appreciably increased the magnetic hysteresis of these alloys. (Referativnyi Zh.)

48997 STUDY OF SOME HALIDES AND THE OXIDES OF SAMARIUM, EUROPIUM, AND GADOLINIUM. Thomas, Henry Howard Jr. Syracuse, N. Y., Syracuse Univ., 1968. 140p. Thesis.

An investigation into the spectroscopic and magnetic properties of several anhydrous rare earth metal halides was conducted. The effect of crystal field splitting on these properties was studied. The compounds prepared were $GdBr_3$, $SmBr_3$, and $NdBr_3$, and the divalent compounds $EuBr_2$, $EuCl_2$, $SmCl_2$, and $SmBr_2$. The following compounds were obtained commercially: EuF_3, $EuCl_3$, SmF_3, $SmCl_3$, GdF_3, and $GdCl_3$. The crystal structures of $EuBr_2$, $SmBr_2$, and $GdBr_3$ are determined from x-ray powder data. The results of pycnometer density measurement results are presented; they support the x-ray data. The solid-state diffuse reflectance spectra are presented for those compounds which possess transitions in the near-infrared or visible regions. A detailed analysis of the spectra of Sm(III) and Nd(III) is presented. The magnetic susceptibility data over the temperature range of 80 to 300°K are presented. The temperature dependence for the isoelectric compounds of Gd(III) and Eu(II) was found to be independent of the halide ion. The susceptibilities of the isoelectric pair Sm(II) and Eu(III) were found to be different for different halides. Two types of behavior were observed: One implies a very narrow splitting of the J = 1 excited level. The susceptibility can thus be accounted for by assuming a fixed separation between the ground and first excited states. The second type of behavior is unaccounted for on this basis, thereby implying a larger splitting of the J = 1 state which cannot be neglected. The susceptibility of Sm(III) was also observed to depend on the crystal field surrounding the ion. Using previously derived equations which relate the susceptibility to the crystal field splitting parameter, it was found that these equations are insufficient to explain the observed results. (TSS) (Diss. Abstr.)

48998 THE EXCITATION OF THE DAUGHTER-ION Rb^+ DUE TO THE SUDDEN CHANGE OF NUCLEAR CHARGE OF ^{85}Kr TRAPPED IN SOLIDS OF RARE GASES. Micklitz, H.; Luchner, K. (Technische Hochschule, Munich). Z. Phys., 227: 301-30 (1969). (In German).

By the sudden change of nuclear charge, the daughter-ion is excited with a probability of some percent (monopole excitation). When ^{85}Kr is trapped in various solids of rare gases, the daughter-ion Rb^+ acts as a probe: The spectra of emitted photons contain information about the influence of the surrounding solid on the levels of the excited Rb^+. These spectra have been observed in delayed coincidence with the nuclear process (β decay); direct excitation by charged particles is excluded. The results are closely connected to the behavior of the decaying atom in free state and solid krypton: There are narrow bands (the daughter-ion occupies a regular lattice site) and blue-shifted ($\Delta\nu$) broad bands (emission

from daughter-ion displaced to interstitial sites by recoil). $\Delta\nu$ is different in the various solids of rare gases and increases from Ar to Xe; this is due to the various polarizabilities and lattice constants. A theoretical estimate fits well the experimental values. Besides, the experimental results show that the excitation-probability for ^{85}Kr in Kr is greater than for ^{85}Kr in Ar or Xe, which also agrees with theoretical estimates. Furthermore, information about the displacement energies of the Rb^+ in the various solids of rare gases are gained from the ratio of intensities of the narrow bands to that of the broad bands, which are compared to displacement energies gained from rare-gas pair potentials. (auth)

48999 POSITRON ANNIHILATION AND ELECTRONIC LATTICE STRUCTURE IN INSULATOR CRYSTALS. Brandt, Werner; Coussot, Gerard; Paulin, Robert (Institut National des Sciences et Techniques Nucleaires, Saclay, France). Phys. Rev. Lett., 23: 522-4(Sept. 8, 1969).

The dimensions of the electronic lattice structure of the hexagonal quartz crystal and the fcc CaF_2 crystal were measured by resolving characteristic markings on the angular-correlation curves as observed for the two gamma quanta emitted in the annihilation of positrons with electrons in these crystals. (auth)

49000 OBSERVATION OF MAGNETO-ELASTIC EFFECTS IN TERBIUM METAL BY FERROMAGNETIC RESONANCE AT λ = 2.5 TO 3 mm. Wagner, T. K.; Stanford, J. L. (Ames Lab., Iowa). Phys. Rev., 184: 505-9(Aug. 10, 1969).

Magneto-elastic effects recently included in theoretical studies of spin-wave spectra of heavy rare-earth metals have suggested that millimeter ferromagnetic-resonance (FMR) results in terbium metal should be reinvestigated. Data are presented from a new detailed study of FMR in single-crystal terbium metal. The data extend over a wider temperature range (13–240°K) than was previously reported, and at frequencies of 98 to 121 GHz. Angular studies were also made. The high-frequency FMR data are qualitatively the same as those reported earlier, and agree qualitatively with theoretical calculations from the model which assumes that elastic strains are "frozen" at the equilibrium (i.e., no spin-wave) configuration. Quantitative fitting of the theory to the data requires values of the anisotropy and magneto-elastic constants that are in reasonable agreement with the results of other studies. The values are $P_3S = -18°K/atom$ and $D^{\lambda} = 1.7$ K/atom. A solution is provided to the puzzling discrepancy which has existed for several years between the earlier high-frequency FMR results and Cooper's theoretical predictions. (auth)

49001 NUCLEAR ORIENTATION BY MEANS OF ROTATIONAL COOLING AND THERMAL MIXING BETWEEN NUCLEAR AND ELECTRONIC SPIN SYSTEMS. Lubbers, J.; Huiskamp, W. J. (Kamerlingh Onnes Laboratorium, Leiden). Physica, 34: 193-211(1967).

Rotational cooling in magnetic fields was performed with a few Ce electron spins ($\approx 10^{18}/cm^3$) included in lanthanum magnesium nitrate. When their energy splittings were made equal to the hyperfine structure splittings of ^{54}Mn nuclei (with a concentration of $\approx 4 \times 10^{12}/cm^3$), a fast ($\approx 10^{-2}$ sec) thermal mixing was observed. A detailed investigation of this mixing process is presented; the mixing rate is quantitatively accounted for by magnetic dipole-dipole interactions. The obtained nuclear polarization of the ^{54}Mn nuclei was $\langle I_z \rangle / I > 97\%$ and could be maintained during at least 2000 sec. The minimum g value of Ce in lanthanum magnesium nitrate was found to be $g_{//} = 0.0235 \pm 0.0009$. (auth)

49002 INTERNAL FIELD MEASUREMENTS IN Ni AND Fe BY THE ANGULAR CORRELATION METHOD. Cisneros, Jorge Ivan (Centro Atomico, Bariloche, Argentina); Liljegren, Goeran; Lindqvist, Torsten; Lopex-Garcia, Alberto. Ark. Fys., 38-71 (1968).

Radioactive ^{111}In atoms were embedded into ferromagnetic Ni and Fe by thermal diffusion. The perturbed angular correlation of the gamma cascade in ^{111}Cd was measured, giving the Larmor frequency ω due to the hf interaction between the nuclear magnetic moment μ and the internal ferromagnetic field H. Measurements were done at 77, 300, 493, and 680°K for Ni and at 300 and 853°K for Fe. Both demagnetized and polarized samples were used. The internal fields at room temperature were -66.2 ± 1.4 kG for Ni and -349 ± 8 kG for Fe. (Sweden)

49003 MEASUREMENTS OF ELECTRIC CONDUCTIVITY OF OXIDES AT ELEVATED TEMPERATURES. Spiridonov, E. G.; Khaikin, R. A.; Ravvina, L. P. Teplofiz. Vys. Temp., 7: 798-800(July-Aug. 1969). (In Russian).

Temperature dependence of electrical resistance of $(ZrO_2)_{0.913} - (Y_2O_3)_{0.087}$ sintered at 1650°C was measured by four- and two-probe methods for ac and dc currents during heating and cooling conditions. (R.V.J.)

49004 STRUCTURAL AND MAGNETIC PROPERTIES OF PSEUDOBINARY SYSTEM $(Zr_{1-x}Nb_x)Fe_2$. Kanematsu, Kazuo (Nihon Univ., Chiba, Japan). J. Phys. Soc. Jap., 27: 849-56 (Oct. 1969).

In pseudobinary system $(Zr_{1-x}Nb_x)Fe_2$, the crystal structure is $MgCu_2$ type for $x \leq 0.3$, $MgZn_2$ type for $x > 0.5$, and six-layer structure for $0.35 < x < 0.5$. The compounds show ferromagnetism for $x \leq 0.4$, antiferromagnetism for $0.4 < x \leq 0.5$, and (Pauli) paramagnetism for $x > 0.5$. It is concluded that the magnetic moment of iron is far larger in $MgCu_2$ structure than in $MgZn_2$ structure. Dominant factors affecting the magnetic polarization of iron are the arrangement of the surrounding atoms as well as the magnetic polarization of the surrounding iron atoms. (auth)

49005 MAGNETIC SUSCEPTIBILITY AND ELECTRICAL RESISTIVITY OF URANIUM PHOSPHIDES AND UP–ThP SOLID SOLUTIONS. Adachi, Hirohiko; Imoto, Shosuke (Osaka Univ.). J. Nucl. Sci. Technol. (Tokyo), 6: 531-5(Sept. 1969).

The magnetic susceptibility and electrical resistivity of uranium phosphides and UP–ThP solid solutions were measured. All the uranium phosphides exhibited paramagnetism at room temperature, and followed the Curie–Weiss law. The Néel point T_N for UP_2 and UP, and the Weiss constant θ were estimated. Ferromagnetic components made their appearance in UP_2 and UP, in the temperature range below T_N. With UP–ThP solid solutions, the changes according to composition observed in the values of T_N and θ indicated that UP is magnetically diluted by ThP, which latter compound is characterized by Pauli paramagnetism, and whose presence contributes to diminish the exchange interactions. The electrical resistivity of UP increased rather rapidly with temperature up to a point corresponding to T_N beyond which the tendency changed sharply to a slightly negative coefficient. ThP showed a consistently low value of resistivity, were slowly rising with temperature, and that of UP–ThP solid solutions revealed a behavior intermediate between those of UP and ThP. (auth)

49006 MOLECULAR PROCESSES ON SOLID SURFACES. Battelle Institute Materials Science Colloquia, Kronberg, Germany, May 6–11, 1968. Drauglis, Edmund; Gretz, Ronald D.; Jaffee, Robert I. (eds.). McGraw-Hill Series in Materials Science and Engineering. New York, McGraw-Hill Book Company, 1969. 666p. (CONF-680553).

Four introductory lectures and twenty-four papers are presented under the following headings: Characterization and Structure, Electronic Interactions, Adsorption, Nucleation and Growth, and Macroscopic Effects. Agenda discussions are also included in which surface tension, physisorption, chemisorption, kinetics, etc. are treated. (D.L.C.)

Moessbauer Effects and NMR

Refer also to abstracts 47712 and 49182.

49007 (COO-1198-663) SENSITIVITY OF NUCLEAR MAGNETIC DOUBLE RESONANCE. Spencer, Paul Roger (Illinois Univ., Urbana). Oct. 1969. Contract AT(11-1)-1198. 121p. Dep. CFSTI.

Thesis.

The dynamics of the nuclear magnetic double resonance process for Na nuclei in a (2,0,0) position relative to a substitutional Ag^+ impurity in NaCl has been studied for several Ag concentrations. The purpose was to determine experimentally the factors which limit the double resonance sensitivity. For Ag concentrations below 0.03 mole %, the magnetization of unperturbed Na nuclei decayed exponentially with rates proportional to the impurity concentration when an rf field at the resonance frequency of the quadrupole-shifted transitions was applied. Using a new method, intermittent search-field irradiation, evidence was found that the finite spin diffusion rate caused a double resonance energy transfer rate under continuous search-field irradiation about 30% less than the transfer rate which would be observed if the spin diffusion were infinitely fast. A theoretical explanation of the results is given using a perturbation approach based on the concept of spin diffusion. In addition, the Na spin lattice relaxation in the completely demagnetized state was studied as a function of impurity concentration, and a rapid initial decrease of spin order found. This was caused by cross relaxation within the nuclear spin system. (auth)

49008 FIRST-ORDER PHASE TRANSITION IN EUROPIUM METAL. Cohen, R. L.; Huefner, S.; West, K. W. (Bell Telephone Labs., Murray Hill, N. J.). Phys. Rev., 184: 263-70 (Aug. 10, 1969).

Moessbauer-effect measurements of the hyperfine (hf) interaction in Eu metal were used to study the behavior of its sublattice magnetization in the vicinity of the magnetic ordering temperature. At 88.6°K, the hf field falls from 0.4 of the saturation value to zero. This results from the existence of a first-order transition coincident with the magnetic ordering. The possible causes of the transition are discussed. The temperature dependence of the hy-

perfine field just below the transition is analyzed in terms of critical-point theory. The results of thermal-expansion measurements are also presented and discussed. (auth)

49009 EFFECT OF RADIO-FREQUENCY FIELDS ON MOESSBAUER SPECTRA. Gabriel, Helmut (Univ. of California, Berkeley). Phys. Rev., 184: 359-63(Aug. 10, 1969).

The effect of a radio-frequency field on Moessbauer spectra is reconsidered. Both the ground and the excited state of the source nuclei are simultaneously exposed to the rf magnetic field. As an example, the effect of the rf field on ^{57}Fe nuclei in a source with magnetic splitting (detected by a single-line absorber) is discussed in detail for two experimental geometries. Moessbauer spectra taken at a constant velocity, but with varying radio frequency, show that the main features can be understood in terms of two-quantum processes (rf-induced transitions between the magnetic sublevels preceding or subsequent to the emission of a γ quantum), as long as the rf amplitude is small compared to the static magnetic field at the nucleus. (auth)

49010 NUCLEAR GAMMA-RAY RESONANCE STUDY OF HYPERFINE INTERACTIONS IN ^{238}U. Ruby, S. L.; Kalvius, G. M.; Dunlap, B. D.; Shenoy, G. K.; Cohen, D.; Brodsky, M. B.; Lam, D. J. (Argonne National Lab., Ill.). Phys. Rev., 184: 374-80(Aug. 10, 1969).

Nuclear γ-ray resonance (the Moessbauer effect) has been observed in ^{238}U using the 44.7-keV transition from the first excited state (2^+) to the ground state (0^+). The γ rays were obtained from the α decay of ^{242}Pu. The source material (PuO_2) gave a single emission line having a width of about 40 mm/sec, which is roughly 1.5 times the natural linewidth. Absorption spectra were taken in the temperature region between 77 and 4.2°K using the following absorbers: UO_2, UC, UF_4, $(UO_2)(NO_3)_2 \cdot 6H_2O$, UO_3, UFe_2, and α-uranium metal. Several compounds showed partially resolved hyperfine spectra. In UO_2, the resonance line broadens by a factor of 2 when cooling from 77 to 4.2°K. By fitting a pure magnetic hyperfine spectrum to the widened line, a hyperfine field of 2700 ± 200 kOe was deduced, using $g(2^+) = g_R = 0.25$. The resonance in $(UO_2)(NO_3)_2 \cdot 6H_2O$ can be explained by a pure electric quadrupole interaction of $e^2qQ = -6100 \pm 225$ MHz. The isomer shift between U^{4+} and U^{6+} compounds is smaller than 2 mm/sec, thus giving a limit for the relative change in nuclear charge radius of $|\delta\langle r^2\rangle/\langle r^2\rangle| \leq 10^{-5}$. (auth)

49011 ON THE EQUIVALENCE OF THE MASS CHANGE SHIFT AND THE SECOND-ORDER DOPPLER SHIFT IN THE MOESSBAUER EFFECT. Trooster, J.; Benczer-Koller, N. (Rutgers-The State Univ., New Brunswick, N. J.). Phys. Lett., 30A: 27(Sept. 8, 1969).

It is shown that the mass change shift and the second-order Doppler shift in the Moessbauer effect are in fact the same phenomenon, in contrast to the assertions by J. T. Dehn in a recent note (Phys. Lett., 29A: 132(1969)). (auth)

49012 MOESSBAUER EFFECT OF THE 129-keV STATE IN ^{195}Pt. Wilenzick, R. M.; Hardy, K. A.; Hicks, J. A.; Owens, W. R. (Tulane Univ., New Orleans). Phys. Lett., 29A: 678-9(Aug. 25, 1969).

The resonance absorption of the 129-keV γ rays from the second excited state in ^{195}Pt was investigated. The spectrum exhibits a 0.16% effect and a linewidth of 4.4 ± 0.4 mm/s. The possibility of using this resonance for solid-state studies is suggested. (auth)

49013 NEW ^{169}Tm MOESSBAUER SOURCE. Wynter, C. I. (Rutgers Univ., New Brunswick, N. J.); Spijkerman, J. J.; Stadelmaier, H. H.; Check, C. H. Nature (London), 223: 1055(Sept. 6, 1969).

Although the lanthanides are rich in Moessbauer isotopes, only a few Moessbauer studies of lanthanide compounds have been reported. Difficulties with Tm compounds in this respect are mentioned. Details are given of the preparation of a $Na_3{}^{169}ErF_6$ source giving an unsplit line at 300°K and a large resonance effect using a 2.3 mg/cm^2 cubic $TmAl_2$ absorber. The pulse-height spectrum of this source relative to a ^{57}CoPd source is shown, the position of the 8.42-keV transition of ^{169}Er and the 6.5-keV $K_{\alpha,\beta}$ x ray of ^{57}Co being clearly indicated. The spectrum of a 2.3 mg/cm^2 single-line $TmAl_2$ absorber against the hexafluoride source is also shown (at 300°K). The observed uncorrected resonance effect was ~48%. It is suggested that this source, with its highly symmetrical hexafluoro environment, might provide single-line sources for all the rare earth Moessbauer active isotopes, and that the corresponding absorbers could be used as standards for reporting future Moessbauer isomer shifts. (UK)

49014 OBSERVATION OF MAGNETIC HYPERFINE SPLITTING IN THE PARAMAGNETIC STATE OF Er AS A DILUTE IMPURITY IN Zr. Hirst, L. L.; Seidel, E. R.; Moessbauer, R. L. (Technische Hochschule, Munich). Phys. Lett., 29A: 673-4(Aug. 25, 1969).

Magnetic hyperfine splitting and relaxation properties of a rare earth impurity in a metallic host were observed in the paramagnetic field by recoilless nuclear gamma resonance absorption. (auth)

49015 NUCLEAR MAGNETIC RESONANCE IN CADMIUM AND TIN. Dickson, Edward Mark. Berkeley, Calif., Univ. of California, 1968. 76p.

Thesis.

Pulsed nuclear magnetic resonance measurements of the spin-lattice relaxation time, T_1, in ^{113}Cd and ^{119}Sn from 77°K to ≈820°K are reported and compared with predictions from the Korringa relation using previously published values of the isotropic Knight shift, K_{iso}. An enhancement of the Korringa product, $T_1TK_{iso}^2$ is observed. The enhancement is constant with temperature but different in the solid and liquid states. The enhancement amounts to a factor of 1.18 in solid ^{113}Cd, 1.43 in liquid ^{113}Cd, 1.33 in solid ^{119}Sn, and 1.25 in liquid ^{119}Sn. For ^{113}Cd the difference between the liquid and solid enhancement is significant and can be related to a core-polarization or orbital contribution to K_{iso} in the solid state that is negative and independent of temperature and which becomes negligible in the liquid state. These two contributions to K_{iso} cannot be separated by this experiment and are collectively called K_{other}. Compared to the contribution to K_{iso} from the contact hyperfine interaction, K_δ, it is found that $K_{other}/K_\delta \approx -9\%$ in solid ^{113}Cd. In liquid ^{113}Cd and solid and liquid ^{119}Sn, K_{other} is probably small. A measurement of T_1 in ^{207}Pb at the single temperature of 77°K is also reported and found to be shorter than predicted by the unenhanced Korringa relation. This implies that there is either a significant relaxation mechanism not accounted for by the Korringa relation or a significant negative K_{other} contribution to K_{iso}. An experimental check on a previous pressure dependence experiment on K_{iso} in ^{113}Cd is reported and found to be in reasonable agreement with the previous experiment, confirming that there is only slight pressure dependence of the isotropic and anisotropic Knight shift in ^{113}Cd. Consequently it has been concluded that the c/a ratio has little effect upon K_{iso} and K_{ax} in Cd. For ^{113}Cd the results of the present T_1 measurements are related to previously published measurements on the isotropic and anisotropic Knight shift, the change of the isotropic Knight shift at the melting point, the magnetic susceptibility, and a recent density of states calculation. Plausible and consistent explanations are advanced for the unusual behavior of these quantities in Cd. The explanations are based upon slight but significant intrinsic temperature dependent changes in the relative proportion of s- and p-character in the wave function of the conduction electrons and the density of states at the Fermi level. (Diss. Abstr.)

49016 NUCLEAR SPIN-LATTICE RELAXATION IN CADMIUM AND TIN. Dickson, E. M. (Univ. of California, Berkeley). Phys. Rev., 184: 294-8(Aug. 10, 1969).

Pulsed nuclear-magnetic-resonance measurements of the spin-lattice relaxation time T_1 in ^{113}Cd and ^{119}Sn from 77 to 820°K are reported. An enhancement of the Korringa product $T_1TK_{iso}^2$ that is constant with temperature but different in the solid and liquid states is observed. For ^{113}Cd, the difference between the liquid and solid enhancement is significant and can be related to a core-polarization or orbital contribution to the isotropic Knight shift K_{iso}. In solid ^{113}Cd, the sum of these two contributions to K_{iso} is about −9% as large as the contribution from the contact hyperfine interaction and that fraction is independent of temperature. In liquid ^{113}Cd and solid and liquid ^{119}Sn, the sum of these contributions is probably small. (auth)

49017 HYPERFINE ANOMALY IN ^{193}Ir BY MOESSBAUER EFFECT, AND ITS APPLICATION TO DETERMINATION OF THE ORBITAL PART OF HYPERFINE FIELDS. Perlow, G. J.; Henning, W.; Olson, D.; Goodman, G. L. (Argonne National Lab., Ill.). Phys. Rev. Lett., 23: 680-2(Sept. 29, 1969).

A 7% hyperfine anomaly is found in Moessbauer measurements of the 73-keV transition in ^{193}Ir. A 2% difference is found between the anomalies in antiferromagnetic IrF_6 and Ir−Fe alloy. The difference is ascribed to orbital contributions which differ for the two iridium environments. By using known details of IrF_6, the orbital field in the Ir−Fe is found to be $H_l = +335 \pm 200$ kOe. (auth)

49018 SELECTIVE EXCITATION OF NUCLEAR SUBLEVELS. Heiman, Neil D. (Johns Hopkins Univ., Baltimore); Walker, J. C.; Pfeiffer, Loren. Phys. Rev., 184: 281-4(Aug. 10, 1969).

A method is described for selectively populating any one of the sublevels of a nuclear excited state by means of the Moessbauer effect. Specifically, a single hyperfine level of the 14.4-keV state of ^{57}Fe was populated using a constant-velocity drive system, a single-line ^{57}Co source, and a metallic ^{57}Fe scatterer arranged in

90° scattering geometry. Polarization was detected by analyzing the scattered radiation with a second Moessbauer drive and a single-line absorber. Two applications of the selective excitation process are also reported. In the first, the energy distribution of the scattered radiation was studied as a function of the Doppler shift of the incident radiation. In the second, NMR transitions between the hyperfine sublevels of the 100-nsec state of ^{57}Fe were directly observed. (auth)

Theoretical Physics

Refer also to abstracts 47877 and 49469.

49019 MOTION OF A CHARGED PARTICLE IN A SPATIALLY PERIODIC MAGNETIC FIELD. Coffey, Timothy P. (Univ. of Michigan, Ann Arbor). J. Math. Phys. (N.Y.), 10: 1362-8(Aug. 1969).

Degenerate perturbation theory is employed to discuss the motion of a charged particle in a constant magnetic field on which is superimposed a weak, transverse, spatially periodic magnetic field. A first-order solution of the equations of motion is presented. It is shown that the secular motion is periodic in time. The significance of this result with respect to the stability of protons in the inner Van Allen belt is discussed. (auth)

49020 LOWER BOUNDS OF ERROR FOR A TRIAL WAVE FUNCTION. Bonelli, Paola; Majorino, Gian Franco. Atti. Accad. Naz. Lincei, Rend., Cl. Sci. Fis., Mat. Natur., 45: 550-5 (Dec. 1968).

A simple approximation formula is demonstrated that gives a value between the square of $\int \varphi H \varphi d\tau$ and $m(m = \int \varphi H^2 \varphi d\tau)$, where H is the Hamiltonian and φ a trial wave function. From such value it is possible to evaluate a lower bound for the variance U^2; calculations reported are in good agreement with the exact values calculated for the hydrogen atom. (W.D.M.)

49021 A NOTE ON QUANTUM-MECHANICAL SUM RULES. Swenson, R. J. (Montana State Univ., Bozeman). Phys. Lett., 29A: 693-4(Aug. 25, 1969).

Hypervirial theorems are used to derive alternative expressions for quantum-mechanical sum rules. Only one of these has normally been used. Considerable additional power lies in requiring approximate wave functions to satisfy each of the different expressions. (auth)

49022 DRIFT MOTION OF CHARGED PARTICLES IN TWO HIGH-FREQUENCY FIELDS ROTATING WITH DIFFERENT ANGULAR VELOCITIES. Soldatenkov, T. R. (Inst. of Physics and Tech., Sukhumi, USSR). Ukr. Fiz. Zh., 14: 1171-6(July 1969). (In Russian).

The equations for the motion of charged particles in the hf field of two waves with different angular velocities are solved in the drift approximation. On the basis of these solutions the regions of finite and infinite particle motion are found, depending on field parameters (amplitudes, frequencies). (auth)

49023 EXACT MOTION OF A CHARGED PARTICLE IN AN ARBITRARY PLANE WAVE PROPAGATING ALONG A CONSTANT HOMOGENEOUS MAGNETIC FIELD. Leer, Egil (Norwegian Inst. of Cosmic Physics, Oslo). Phys. Fluids, 12: 2206-10(Oct. 1969).

The classical relativistic equations of motion are solved for a charged particle moving in an arbitrary plane electromagnetic wave propagating along a constant homogeneous magnetic field. The solutions are expressed by (proper time) evolution tensor factors, operating upon the initial value quantities. The calculations are performed in terms of tensor-component matrices. Elliptically polarized waves are then considered. At resonance frequency an expression for the increase in the kinetic energy is obtained. This expression shows that the kinetic energy increases indefinitely, and that the energy exchange is caused by the field component rotating in the same direction as the particle. (auth)

49024 PARTIAL DIFFERENTIAL EQUATION FOR THE TIME-DEPENDENT PROBABILITY DENSITIES OF QUANTUM MECHANICS. Kostin, M. D. (Princeton Univ., N. J.). Amer. J. Phys., 37: 898-9(Sept 1969).

The Schroedinger equation for the wave functions is used to derive a linear partial differential equation for the time-dependent probability densities, $(\hbar^2/4m)[\partial^3 P(x,t)/\partial x^3] = 2V(x)(\partial P/\partial x) + V' P(x,t) - 2[\partial \epsilon(x,t)/\partial x] - m[\partial j(x,t)/\partial t]$, where $P(x,t)$, $\epsilon(x,t)$, $j(x,t)$ are the time-dependent position, energy, and current densities, respectively. In the limiting case where the system is in the nth quantum state, it is shown that this partial differential equation reduces to the previously derived third-order ordinary differential equation for the probability position density. (auth)

49025 THEORY OF SYNCHROTRON RADIATION IN THE MOVEMENT OF ELECTRONS IN A SPIRAL. Sokolov, A. A.; Zhukovskii, V. Ch.; Kolesnikova, M. M.; Nikitina, N. S.; Shishanin, O. E. Izv. Vyssh. Ucheb. Zaved., Fiz., No. 2, 108-16(1969). (In Russian).

Universal formulas were adjusted and corrected for synchrotron radiation during the movements of electrons in a constant and homogeneous magnetic field, when trajectories are spiral. This makes possible significant extension of the field of application of approximation methods for investigation of synchrotron radiation given the longitudinal rate components. (tr-auth)

PHYSICS (HIGH ENERGY)

Particle Interactions and Properties (Experimental)

Refer also to abstract 49062.

49026 CZASTKI ELEMENTARNE JADRO ATOMOWE PROMIENIOTWORCZOSC. (Elementary Particles, Atomic Nucleus, Radioactivity). Danysz, Marian; Hurwic, Jozef; Natanson, Ludwik; Pniewski, Jerzy (eds.). Warsaw, Panstwowe Wydawnictwo Naukowe, 1967. 435p.

Seventeen articles are included on the data presented by Polish scientists on nuclear physics, elementary particles, nuclear chemistry, radiation chemistry, Mössbauer effects in physics, spectrometry, transuranic elements, and uranium electron structures. (R.V.J.)

Electromagnetic

Refer also to abstract 49184.

49027 (UCLA-34-P-106-42) IN SEARCH OF THE ROPER RESONANCE IN $\pi^- + p \rightarrow \gamma + n$. Nefkens, B. M. K.; Berardo, P.; Haddock, R. P.; Verhey, L. J.; Zeller, M. E. (California Univ., Los Angeles); Parsons, A. S. L.; Truoel, P. (California Univ., Berkeley). Sept. 4, 1969. Contract AT(11-1)-34. 8p. (CONF-690911-1). Dep. CFSTI.

From International Symposium on Electron and Photon Interactions at High Energies, Daresbury, England.

A measure is made of the differential cross section for $\pi^- + p \rightarrow \gamma + n$ interactions at 490 MeV/c. The momentum was selected to determine whether the Roper resonance would be strongly photoproduced on a neutron target. Scintillation counters and spark chambers were used in the study. The results for the differential cross section for $\pi^- + p \rightarrow \gamma + n$ were converted to the $\gamma + n \rightarrow \pi^- + p$ interaction under the assumption of time reversal invariance. Disagreement with previous results is found. No evidence was found, for the classification of the Roper in an antidecuplet. (J.F.P.)

49028 SCATTERING OF HIGH-ENERGY POSITIVE AND NEGATIVE MUONS ON ELECTRONS. Jain, P. L.; Wixon, N. J. (State Univ. of New York, Buffalo). Phys. Rev. Lett., 23: 715-18 (Sept. 29, 1969).

The elastic interaction of 10.1-GeV/c positive and 14.5-GeV/c negative muons with electrons in nuclear emulsion was studied. Energies of the knock-on electrons calculated from scattering measurements were comparable with those obtained from their ejection angles. In the case of both positive and negative muon-electron elastic scattering one did not observe any departure of the muon from a Dirac-type particle with transferred energies up to 1.4 and 3 GeV, respectively. This is in contradiction with some of the previous results. (auth)

49029 SEARCH FOR MESONS SUGGESTED BY THE VENEZIANO MODEL. McClellan, G. (Cornell Univ., Ithaca, N. Y.); Mistry, N.; Mostek, P.; Ogren, H.; Osborne, A.; Silverman, A.; Swartz, J.; Talman, R.; Diambrini-Palazzi, G. Phys. Rev. Lett., 23: 718-20(Sept. 29, 1969).

Recent Regge-pole models have predicted the existence of particles of well-defined mass lying on daughter trajectories of such known particles as the ρ. A search for the coherent photoproduction of these mesons from carbon was made. None was found. It was concluded that in the mass range 1.0 to 1.8 GeV such mesons are coupled to the photon or the nucleus, at least two orders of magnitude more weakly than is the ρ. (auth)

49030 HIGH-ENERGY PHOTOPRODUCTION OF CHARGED PIONS AT BACKWARD ANGLES. Anderson, R. L.; Gustavson, D.; Johnson, J.; Overman, I.; Ritson, D.; Wilk, B. H. (Stanford Linear Accelerator Center, Calif.). Phys. Rev. Lett., 23: 721-4 (Sept. 29, 1969).

Measurements on large-angle photoproduction of π^+ mesons from hydrogen were made at the Stanford Linear Accelerator Center for photon energies between 5 and 15.5 GeV and u values from +0.05 to -1.8 $(GeV/c)^2$. The measured cross section decreased with energy approximately as k^{-8}, showing no shrinkage in this range of u values. Furthermore, it had a smooth u dependence with no sign of a dip at $u \simeq -0.15$ $(GeV/c)^2$ as would be expected from nucleon exchange. $\pi^-\Delta^{++}$ production was measured at 5 GeV and shows a rapid decrease with increasing $|u|$. (auth)

49031 π^0 PHOTOPRODUCTION FROM HYDROGEN AT BACKWARD ANGLES. Tompkins, D. (Univ. of Pennsylvania, Philadelphia); Anderson, R.; Gittelman, B.; Litt, J.; Wilk, B. H.; Yount, D.; Minten, A. Phys. Rev. Lett., 23: 725-9(Sept. 29, 1969).

Cross sections for π^0 photoproduction from hydrogen in the backward direction were measured for photon energies of 6, 8, 12, and 18 GeV. The range of momentum transfer covered in these measurements is -1 $(GeV/c)^2 < u < 0$ $(GeV/c)^2$. $d\sigma/du$ is found to have a backward peak and decreases with energy as $s^{-3.0\pm0.2}$. Photoproduction of η^0 and ρ^0 mesons was also observed. (auth)

49032 EXPERIMENTAL PROGRAM AT THE STANFORD LINEAR ACCELERATOR CENTER. Diebold, R. (Stanford Linear Accelerator Center, Calif.). pp 815-45 of Methods in Subnuclear Physics. Vol. III. Nikolic, M. (ed.). New York, Gordon and Breach Science Publishers Inc., 1969.

The study covers $e^- + p$ elastic scattering, positron to electron elastic scattering ratio, inelastic electron scattering, elastic and inelastic muon scattering and asymmetric muon pair photoproduction to test quantum electrodynamics. Also covered are high-energy photoproduction in the forward direction, meson photoproduction using a two-meter streamer chamber, meson (ρ^0) photoproduction, and photoproduction in the SLAC bubble chamber. Beam surveys, a search for new particles, meson (K_2^0) decay asymmetry, and the 82-inch hydrogen bubble chamber are studied. The results presented are preliminary. (J.F.P.)

49033 THE POSSIBILITY OF DETERMINING THE MAGNETIC MOMENT OF THE Σ^0-HYPERON. Cadzhiev, S. A. Izv. Akad. Nauk Azerb. SSR, Ser. Fiz.-Tekh. Mat. Nauk, No. 6, 98-102(1968). (In Russian).

The possibility of using the bremsstrahlung radiation from the two following reactions to determine the magnetic moment is explored: 1) $K^- + n \rightarrow \Sigma^0 + \pi^- + \gamma$, and 2) $K^- + p \rightarrow \Sigma^0 + \pi^0 + \gamma$. The matrix elements of the reaction are determined in the form of contributions from the emission of a photon. A study of the angular distribution of the reaction shows that the reaction takes place in the S-state. The angular and energy distributions of the photons are found. Maximum radioactive emission takes place at θ equal to 90°. The number of photons emitted in the forward and backward directions differ substantially. This difference leads to the existence of an angular asymmetry. The magnetic moment of the Σ^0-hyperon can be determined by measuring the coefficient of angular asymmetry of photons of a definite energy for incident 600 MeV K^--mesons. Photons of energy greater than 40 MeV should be measured to determine the magnetic moment. (TTT)

49034 TWO-BODY HIGH-ENERGY PHOTODISINTEGRATION OF ^{4}He. Picozza, P. (CNEN, Frascati, Italy); Schaerf, C.; Scrimaglio, R.; Goggi, G.; Piazzoli, A.; Scannicchio, D. Nuovo Cim., Lett., 2: 445-8(Sept. 21, 1969).

The differential cross section for the interaction $\gamma + {}^4\text{He} \rightarrow p + t$ was measured at 90° cms at a photon energy between 200 and 460 MeV using telescopes of spark chambers and scintillation counters. The most relevant feature of the cross sections is a pronounced resonant behavior in the energy region of the first pion–nucleon isobar. (J.F.P.)

49035 ANALYSIS OF THE REACTION $\gamma + p \rightarrow p + \pi^+ + \pi^-$ AT ENERGIES UP TO 1 GeV IN A HYDROGEN BUBBLE CHAMBER. Gialanella, G. (Univ., Rome. Istituto Nazionale di Fisica Nucleare, Rome); Piazza, A.; Susinno, G.; Fiore, L.; Mantovani, G. C. Nuovo Cim., 63A: 892-914(Oct. 1, 1966).

The final result of an experiment of double charged-pion photoproduction on proton up to 1 GeV is reported. The most striking feature is the very abundant production of the Δ-isobar in the $\Delta^{++}(\pi^+p)$ charge state and the very low production percentage of its neutral charge state (π^-p). This fact, together with the evident peak of the total cross-section at $E_\gamma = 650$ MeV, suggests trying to fit the data with an isobar excitation model, the intermediate state having $T = \frac{1}{2}$. However, definite conclusions on the formation of the P_{11} resonance cannot be drawn. A good fit of the angular distributions of the Δ^{++} production is obtained with second-order polynomials in $\cos\theta$. The mass distribution of the $(\pi^+\pi^-)$ system does not show any enhancement, which may be attributed to a $(\pi^+\pi^-)$ resonance with mass below 600 MeV/c^2. (auth)

Weak

Refer also to abstracts 49099, 49100, 49106, 49175, and 49184.

49036 (UCRL-19246) ASYMMETRY PARAMETERS IN $\Sigma^- \rightarrow ne^-\bar{\nu}$ AND $\Sigma^+ \rightarrow p\gamma$. Gershwin, Lawrence Kenneth (California Univ., Berkeley. Lawrence Radiation Lab.). June 2, 1969. Contract W-7405-eng-48. 117p. Dep. CFSTI.

Thesis.

An experiment was performed in the Lawrence Radiation Laboratory 25-inch hydrogen bubble chamber. 1.3×10^6 pictures were taken of the interactions of a K^- beam ranging in momentum from 270 to 470 MeV/c, with most of the pictures taken in the vicinity of 390 MeV/c, where the $Y_0^*(1520)$ resonance is formed. The interference of the resonant amplitude with those of the predominantly S-wave background produces polarized Σ's in the reactions $K^-p \to \Sigma^-\pi^+$ and $K^-p \to \Sigma^+\pi^-$. From a sample of 85,000 $\Sigma^- \to n\pi^-$ decays and 57,000 $\Sigma^+ \to p\pi^0$ decays 53 examples of $\Sigma^- \to ne^-\bar{\nu}$, 8 of $\Sigma^- \to n\mu^-\bar{\nu}$, and 61 of $\Sigma^+ \to p\gamma$ were found. The leptonic Σ^- decays were analyzed to measure the correlation between the Σ^- polarization and the direction of the charged lepton, as described by the lepton distribution $(1 + \alpha P_\Sigma \cos\theta)$. The asymmetry parameter α for the electron events was found to be $\alpha = -0.26 \pm 0.37$. The asymmetry parameter is related to g_A/g_V, the ratio of the axial-vector to vector weak coupling constants. It was found that $g_A/g_V = 0.16^{+0.19}_{-0.18}$ for the electron events. The sign convention is such that $g_A/g_V = -1.2$ for $n \to pe^-\bar{\nu}$. Assuming μ-e universality, it was found that $g_A/g_V = 0.19^{+0.20}_{-0.17}$ for the combined electron and muon events. A comparison with Cabibbo's theory of semi-leptonic decays showed reasonable agreement with the prediction of the theory when a fit was carried out to presently published data for baryon leptonic decays. For the 61 $\Sigma^+ \to p\gamma$ events, the asymmetry parameter expressing the correlation of the Σ^+ polarization with the direction of the proton, was measured obtaining $\alpha = -1.03^{+0.52}_{-0.43}$. The branching ratio $(\Sigma^+ \to p\gamma)/(\Sigma^+ \to p\pi^0) = (2.76 \pm 0.51) \times 10^{-3}$ was measured, using 31 of the $\Sigma^+ \to p\gamma$ events. It was found that both the branching ratio and asymmetry parameter to be in agreement with some theoretical calculations, although the asymmetry parameter is two standard deviations from the value $\alpha = 0$ predicted by SU(3) invariance. (auth)

49037 EVIDENCE FOR VIOLATION OF THE $\Delta I = 1/2$ RULE IN $K^+ \to 3\pi$ DECAY. Grauman, J. (Stevens Inst. of Tech., Hoboken, N. J.); Taylor, S.; Koller, E. L.; Pandoulas, D.; Hoffmaster, S.; Raths, O.; Romano, L.; Stamer, P.; Kanofsky, A.; Mainkar, V. Phys. Rev. Lett., 23: 737-8(Sept. 29, 1969).

A significant violation of the $\Delta I = 1/2$ rule was detected in $K^+ \to 3\pi$ decay. The ratio of the coefficients of the linear terms in the squared matrix elements of τ'^+ $(K^+ \to \pi^+ + 2\pi^0)$ and τ^+ $(K^+ \to 2\pi^+ + \pi^-)$ is found to be -2.63 ± 0.18 (as compared with the $\Delta I = 1/2$ rule prediction of -2), when the results of the Riverside τ'^+ experiment are used together with the results of the present τ^+ experiment. (auth)

49038 WHAT CAN WE LEARN FROM K_{e4} DECAYS? Fry, W. F. (Univ. of Wisconsin, Madison). pp 187-202 of Methods in Subnuclear Physics. Vol. III. Nikolic, M. (ed.). New York, Gordon and Breach Science Publishers Inc., 1969.

A brief theoretical and experimental review is given of the K_{e4} decays. The experimental results and interpretation discussed include the K_{e4} branching ratio, the di-pion mass spectrum, and angular correlations. (28 references) (J.F.P.)

49039 EXPERIMENTAL SEARCH FOR WEAK NEUTRAL CURRENTS. Cline, D. (Univ. of Wisconsin, Madison). pp 355-71 of Methods in Subnuclear Physics. Vol. III. Nikolic, M. (ed.). New York, Gordon and Breach Science Publishers Inc., 1969.

The results of recent experimental searches for weak processes requiring neutral current interactions are discussed. Also some theories for explaining the possible absence of these currents are considered. The vector boson theory of weak interactions, experimental evidence concerning neutral currents, hadronic versus neutral currents, induced neutral currents and CP violation in neutral current processes, and theoretical proposals concerning the absence of neutral lepton currents are discussed. (24 references) (J.F.P.)

49040 THE $K_0 - \bar{K}_0$ SYSTEM. Aubert, B. (Laboratoire de l'Accelerateur Lineaire, Orsay, France). pp 245-312 of Methods in Subnuclear Physics. Vol. III. Nikolic, M. (ed.). New York, Gordon and Breach Science Publishers Inc., 1969.

The relations involving parameters of K^0 decay are reviewed. The $K^0 - \bar{K}^0$ system, measurements of the average lifetimes and mass difference, selection rules for K^0 decay, violation of the CP hypothesis and the experimental view of CP violation are covered. (110 references) (J.F.P.)

49041 MEASUREMENT OF THE MUON DECAY ASYMMETRY AT LOW ENERGY. Vossler, C. (Univ. of Chicago). Nuovo Cim., 63A: 423-41(Sept. 21, 1969).

The asymmetry of low-energy positrons produced in μ^+ decay was measured in a hydrogen bubble chamber which was calibrated as a low-energy electron spectrometer. A fit to the expression $1 + A(x)\cos\theta$ gives the values $A(0.03 < x \leq 0.13) = -0.16 \pm 0.04$ and $A(0.13 < x \leq 0.26) = -0.20 \pm 0.04$, where x is the positron momentum in units of the maximum momentum. These results agree with the V–A theory using radiative corrections as calculated by Kinoshita and Sirlin. As a check of the method the asymmetry was measured for the whole spectrum with the result $\langle A \rangle = +0.32 \pm 0.03$ in agreement with the V–A theory and with previous experiments. All existing μ^+ decay data are reviewed to determine the extent to which radiative corrections can be established experimentally if one does not assume a V–A theory. (auth)

Strong (Baryon-Induced)

49042 (KFKI-19/1969) A SURVEY OF THE ANGULAR DISTRIBUTION DATA ON n-p SCATTERING BELOW 10 MeV. Czibok, T. (Magyar Tudomanyos Akademia Kozponti Fizikai Kutato Intezete, Budapest). July 29, 1969. 5p. Dep. CFSTI (U. S. Sales Only).

A review is given of the angular distributions for n + p interactions at 2.5, 3.27, and 8.8 MeV. The data suggest the presence of a complex structure in the differential cross sections. (J.F.P.)

49043 (NYO-3651-11) STUDY OF $\Sigma^- + p \to \lambda + n$ AND $\Sigma^- + p \to \Sigma^0 + n$ REACTIONS AT P_{Σ^-} BETWEEN 0 AND 600 MeV/c. Yamamoto, S. Steven; Stephen, David; Meisner, Gerald W.; Kofler, Richard R.; Hertzbach, Stanley S.; Button-Shafer, Janice (Massachusetts Univ., Amherst); Yamin, Peter; Berley, David (Brookhaven National Lab., Upton, N. Y.). [Sept. 4, 1969]. Contract AT-(30-1)-3651. 13p. (CONF-690503-5). Dep. CFSTI.

From International Conference on Hypernuclear Physics, Argonne, Ill.

Preliminary results are presented for the interactions $\Sigma^- + p \to \Lambda + n$ and $\Sigma^- + p \to \Sigma^0 + n$ using polarized Σ^-'s from the interaction $K^- + p \to \Sigma^- + \pi^+$ at 400 MeV/c in a bubble chamber. The branching ratios $r = \sigma(\Sigma^- + p \to \Sigma^0 + n)/\sigma(\Sigma^- + p \to \Lambda + n) + \sigma(\Sigma^- + p \to \Sigma^0 + n)$ are listed for various energy ranges. And also the average Σ^- and Λ polarizations are given. (J.F.P.)

49044 (PPAR-23) REMARKS ON THE REACTION $p + d \to X^0 + {}^3He$: NEW PROBES OF NUCLEAR CORRELATIONS AT SMALL DISTANCES AND SU(3) SYSTEMATICS. Barshay, Saul (Princeton-Pennsylvania Accelerator, Princeton, N. J.). Aug. 25, 1969. Contract AT(30-1)-2137. 8p. Dep. CFSTI.

The possible experimental investigation of the interaction $p + d \to X^0 + {}^3He$ at high energies is considered. The kinds of information which can be obtained from this study are discussed. (J.F.P.)

49045 SEARCH FOR THE INTERMEDIATE VECTOR BOSON. Wanderer, P. J. (Yale Univ., New Haven); Stefanski, R. J.; Adair, R. K.; Ankenbrandt, C. M.; Larsen, R. C.; Leipuner, L. B.; Smith, L. W. Phys. Rev. Lett., 23: 729-34(Sept. 29, 1969).

A search for the vector boson (W particle), postulated as the mediator of the weak interaction, was carried out by determining the intensity and polarization of muons originating very near the point of interaction of 28-GeV protons with nucleons. Bosons were not observed and the upper limit on the production cross section for W's with masses between 2.0 and 4.5 GeV/c^2 is $B\sigma \lesssim 6 \times 10^{-36}$ cm^2, where B is the branching ratio for the W decay to a muon and a neutrino. (auth)

49046 RECESSION-VELOCITY ANALYSIS OF NUCLEON–NUCLEON INTERACTIONS. Peak, L. S. (Univ. of Sydney). Nuovo Cim., 63A: 400-10(Sept. 21, 1969).

The similarities between nucleon-nucleon interactions at cosmic-ray and at machine energies are investigated. The method of analysis involves calculating the effective recession velocities in the center-of-mass system as implied by the observed two-humped angular distributions. It is concluded that machine events producing one or two π-mesons proceed largely via resonance channels; whereas machine multipion interactions (which are difficult to analyze conventionally) display characteristics similar to cosmic-ray interactions giving rise to the suggestion of both resonance and pionization centers being present. (auth)

49047 STUDY OF NUCLEON ISOBAR PRODUCTION IN PROTON–PROTON COLLISIONS. Blair, I. M. (Atomic Energy Research Establishment, Harwell, Eng.); Taylor, A. E.; Chapman, W. S.; Kalmus, P. I. P.; Litt, J.; Miller, M. C.; Sherman, H. J.; Astbury, A.; Scott, D. B.; Walker, T. G. Nuovo Cim., 63A: 529-54(Sept. 21, 1969).

The momentum spectra of protons scattered inelastically in proton-proton collisions were obtained in an external beam at NIMROD, using incident-proton momenta of 2.85, 4.55, 6.06 and 7.88 GeV/c, and various scattering angles in the range 22 to 144 mrad. The isobars of mass 1236, 1518 and 1688 MeV are clearly seen. There is evidence also in the spectra at small angles for the production of the 1410 MeV isobar at a mass of (1410 ± 15) MeV and width (125 ± 20) MeV. It is shown that the observed peak

cannot be explained by the Deck effect. The differential cross sections for the production of these isobars are presented in terms of the usual variables s and t, and are compared with absorption and Regge-pole model predictions. Fits to the data with various empirical functions of these variables are also investigated. The behavior of the total cross section for the 1236 MeV isobar is found to exhibit energy-dependence consistent with one-pion exchange, whereas the 1410 MeV and 1688 MeV isobar total cross sections are found to be energy-independent. Also the total cross section for the 1518 MeV isobar is found to exhibit energy-dependence in this energy range. (auth)

49048 EXPERIMENTAL EVIDENCE FOR $Y_1^*(1520) \rightarrow Y_1^*(1385) + \pi$ AND CONFIGURATION MIXING. Cline, D.; Laumann, R.; Mapp, J. (Univ. of Wisconsin, Madison). Contract AT(11-1)-881. Nuovo Cim., Lett., 2: 407-10(Sept. 21, 1969). (COO-881-194).

The processes $K^- + d \rightarrow \Lambda + \pi^- + \pi^+ (\pi^0) + n(p)$ were studied at 400 MeV/c in a bubble chamber. The ratio of cross sections is given for the two channels studied, and the isotopic-spin structure of the $\Lambda\pi\pi$ system can be obtained. Although the quantum numbers of the $\Lambda\pi\pi$ system cannot be determined, the Λ angular distribution is inconsistent with the $\frac{1}{2}^+$ or $\frac{1}{2}^-$ assignments. The fact that the F−B ratio changes sign in this mass range suggests that the $\Lambda(1520)$ decay into $\Lambda\pi\pi$ is dominant. Also the observed F−B ratios are not inconsistent with a dominant contribution of the decay $\Lambda(1520) \rightarrow \Sigma(1385) + \pi \rightarrow \Lambda + \pi + \pi$. It is estimated that above 10% of the $\Lambda(1520) \rightarrow \Lambda\pi\pi$ decay goes by this sequence. This assumption leads to a total $\Sigma(1385) + \pi$ branching ratio of 1% and a partial width of above 0.2 MeV. The observation of the studied decay mode of the $\Lambda(1520)$ indicates that this resonance is not a pure SU(3) singlet. (J.F.P.)

49049 OBSERVATION OF THE $Y_1^*(1480)$ IN THE $(\Sigma\pi)^+$ AND $(p\,\overline{K}^0)$ SYSTEMS; COMMENTS ON SPIN AND SU(3) MULTIPLET ASSIGNMENT. Pan, Yu-li; Forman, Fred L. (Univ. of Pennsylvania, Philadelphia). Phys. Rev. Lett., 23: 808-11(Oct. 6, 1969).

The observation of a resonance in the $\Lambda\pi^+$ system at 1480 MeV was recently reported. This same resonance was observed decaying into the $(\Sigma\pi)^+$ and $(p\overline{K}^0)$ channels. The mass, width, and branching ratios for this resonance are presented. Comments on the spin of the $Y_1^*(1480)$ and its possible SU(3) multiplet assignment are presented. (auth)

49050 ON THE MONOTONIC VARIATION OF THE n–p TOTAL CROSS SECTION WITH ENERGY IN THE RANGE 1.0 TO 7.9 MeV. Clements, P. J. (Nuclear Physics Lab., Oxford); Langsford, A. Phys. Lett., 30B: 25-6(Sept. 1, 1969).

A high precision measurement of the n-p total cross section between 1.0 and 7.9 MeV shows no evidence for the presence of an oscillatory term. This term, if it exists, must be less than 6 mb in magnitude. (auth)

49051 A SEARCH FOR STRUCTURE IN THE n–p SCATTERING CROSS SECTION. Schwartz, R. B.; Schrack, R. A.; Heaton, H. T. (National Bureau of Standards, Washington, D. C.). Phys. Lett., 30B: 36-8(Sept. 1, 1969).

The n-p total cross section has been measured in the energy range 1.5 to 15 MeV with good energy resolution and high statistical accuracy. No evidence of structure was found. (auth)

Strong (Meson-Induced)

Refer also to abstract 49184.

49052 EVIDENCE FOR A $\Lambda\pi^+$ RESONANCE AT 1480 MeV. Pan, Yu-li; Forman, Fred L. (Univ. of Pennsylvania, Philadelphia). Phys. Rev. Lett., 23: 806-8(Oct. 6, 1969).

An enhancement in the $\Lambda\pi^+$ mass spectrum has been observed at 1480 MeV in the reaction $\pi^+p \rightarrow K^+\pi^+\Lambda$ at 1.7 GeV/c. In addition, the Λ polarization undergoes a sharp oscillation in the same $\Lambda\pi$ mass region. The best fit values for this resonance are $M = 1480 \pm 15$ MeV and $\Gamma = 35 \pm 20$ MeV. (auth)

49053 INELASTIC SCATTERING OF NEGATIVE PIONS FROM DEUTERONS AT 5.53 GeV/c. Chase, R. C.; Coleman, E.; Courant, H. W. J. (Univ. of Minnesota, Minneapolis). Phys. Rev. Lett., 23: 811-13(Oct. 6, 1969).

The differential cross sections for the total scattering and the inelastic scattering of negative pions by deuterium for 5.53-GeV/c incident pion momentum have been measured over the squared four-momentum transfer interval from ~0.3 $(GeV/c)^2$ to ~1.0 $(GeV/c)^2$. The results are compared with calculations based upon the impulse approximation and the Glauber approximation. (auth)

49054 POLARIZATION IN ELASTIC K^+p SCATTERING BETWEEN 0.86 GeV/c AND 1.45 GeV/c: RESULTS AND PHASE-SHIFT ANALYSIS. Andersson, S.; Daum, C.; Erne, F. C.; Lagnaux, J. P.; Sens, J. C.; Udo, F.; Wagner, F. (CERN, Geneva). Phys. Lett., 30B: 56-60(Sept. 1, 1969).

Polarization and differential cross-section data at 0.86, 0.97, 1.09, 1.37 and 1.45 GeV/c are presented. An energy-independent phase-shift analysis from threshold up to 1.45 GeV/c using random searches at 19 momenta and the shortest path method to link solutions at different momenta, yields three solutions. One of these is unlikely; the other two coincide up to 0.86 GeV/c, and both show an anticlockwise half-circle in the P_3-wave. (auth)

49055 STUDY OF RESONANCE PRODUCTION IN SIX-PRONGED π^-p INTERACTIONS AT 7.0 GeV/c. Campbell, J. E.; Ijaz, M. A. (Virginia Polytechnic Inst., Blacksburg). Nucl. Phys., B12: 549-60(1969).

Six-prong events from π^-p interactions in a hydrogen bubble chamber with a beam momentum of 7.0 GeV/c were analyzed. The total six-prong cross section is 2.40 ± 0.15 mb. The reactions studied are: $\pi^-p \rightarrow \pi^-\pi^-\pi^-\pi^+\pi^+p$ (0.26 ± 0.03 mb) (1), $\pi^-p \rightarrow \pi^-\pi^-\pi^-\pi^+\pi^+p\pi^0$ (0.63 ± 0.09 mb) (2), and $\pi^-p \rightarrow \pi^-\pi^-\pi^-\pi^+\pi^+\pi^+n$ (0.29 ± 0.04 mb) (3). There is significant production of $\Delta^{++}(1238)$ and $\rho(760)$ in reaction (1). Reaction (2) shows $\Delta^{++}(1238)$. The $p\pi^0$ mass distribution in reaction (2) shows an enhancement at 1540 ± 20 MeV/c^2 with a width of 100 ± 40 MeV/c^2 (interpreted as $N^*(1520)$). In the $\pi^+\pi^+\pi^-\pi^-$ invariant mass distribution, we observe two enhancements—one at 1085 ± 20 MeV/c^2 with a width of 70 ± 30 MeV/c^2. The second at 1470 ± 20 MeV/c^2 with width 60 ± 25 MeV/c^2 these two enhancements appear less prominently in the $\pi^+\pi^+\pi^-\pi^-$ mass spectrum in reaction (3). (auth)

49056 DECAY MODES AND QUANTUM NUMBERS OF THE RESONANCE $\pi(1640)$ PRODUCED IN 11 GeV/c π^-p INTERACTIONS. Caso, C. (Univ., Genoa. Istituto Nazionale di Fisica Nucleare, Genoa); Conte, F.; Tomasini, G.; Cantore, A.; Mandelli, L.; Ratti, S.; Vegni, G.; Gandois, B.; Daudin, A.; Mosca, L. Nuovo Cim., Lett., 2: 437-44(Sept. 21, 1969).

The interaction $\pi^- + p \rightarrow p + 2\pi^- + \pi^+$ obtained from passing an 11 GeV/c meson (π^-) through a hydrogen bubble chamber is discussed. The branching ratios of the various decay modes $\pi^-(1640) \rightarrow f^0\pi^-$, $\rho^0\pi^-$, and $\pi^+ + 2\pi^-$ are determined by a maximum-likelihood analysis of the Dalitz plot for the events in the $\pi^-(1640)$ mass region. Also the dominant decay mode $\pi^-(1640) \rightarrow f^0 + \pi^-$ is studied to determine the spin and parity for the $\pi^-(1640)$. (J.F.P.)

49057 ON π^-N INTERACTIONS AT 60 GeV/c AND $\overline{N}N$ ANNIHILATION. Wang, Chia Ping (Case Western Reserve Univ., Cleveland). Phys. Let., 30B: 115-18(Sept. 15, 1969).

The 60 GeV/c π^-N Serpukhov data were found to follow exactly the distribution W^1n, given previously by the author, and the multiplicities in $\overline{N}N$ annihilation, a corresponding binomial distribution. The structural difference of pion and nucleon above 10^{12} eV is discussed. (auth)

49058 COHERENT PRODUCTION OF RESONANCES. Pevsner, A. (John Hopkins Univ., Baltimore). pp 249-63 of Meson Spectroscopy. Baltay, Charles (ed.). New York, W. A. Benjamin, Inc., 1968.

Results are reported of experiments from several laboratories on coherent production of resonances from K^- reactions with deuterium and neon targets. Various diffraction models used to explain the resonances are compared with experimental data. (L.B.S.)

49059 SPECTRUM OF CHARGED NON-STRANGE BOSONS IN THE MASS REGION 2.5 TO 3.0 GeV. Baud, R.; Benz, H.; Bosnjakovic, B.; (and others) (CERN, Geneva). Phys. Lett., 30B: 129-32(Sept. 15, 1969).

The CERN boson spectrometer shows significant enhancements in the spectrum of charged non-strange bosons near 2.6 GeV and 2.8 GeV mass values. (auth)

49060 NEUTRAL-DECAY MODE OF η^0 and ω^0 MESONS. Jacquet, F. (Ecole Polytechnique, Paris); Nguyen-Khac, U.; Haatuft, A.; Halsteinslid, A. Nuovo Cim., 63A: 743-60(Oct. 1, 1969).

A study of the $n\gamma$ (n = 3, 4, 5, 6) system in the reaction $\pi^+p \rightarrow \pi^+p\,n\gamma$ was made using a hydrogen target inside the Ecole Polytechnique heavy-liquid bubble chamber. Directions and momenta of charged tracks and γ-rays are measured. Neutral-decay mode of ω^0 and η^0 were studied with direct identification of secondaries (γ or π^0). The branching ratios and cross sections were determined with 95% of confidence. (auth)

Particle Interactions and Properties (Theoretical)

General

Refer also to abstracts 49181, 49212, 49214, and 49216.

49061 (CALT-68-221) CONJECTURED SET OF EXACT BOOTSTRAP EQUATIONS. Chu, Shu-Yuan; Kaus, P. (California Univ., Riverside); Zachariasen, F. (California Inst. of Tech., Pasadena). Sept. 1969. Contract AT(11-1)-68. 24p. (CTSL-IR-45). Dep. CFSTI.

A set of exact bootstrap equations is conjectured, consisting of two coupled homogeneous equations for the vertex function and the propagator from which any n-legged amplitude can be constructed. One equation is analogous to the vanishing of vertex renormalization constants (Z = 0); the second equation expresses "duality." All graphs can be reduced to the simple tree diagram. Amplitudes, if solutions exist, will be crossing symmetric and have at least all the necessary singularities making unitarity plausible but not proved. (auth)

49062 METHODS IN SUBNUCLEAR PHYSICS. VOLUME III. Proceedings of the International School of Elementary Particle Physics, Herceg-Novi, Yugoslavia. Nikolic, M. (ed.). New York, Gordon and Breach Science Publishers Inc., 1969. 879p. $69.50.

Separate abstracts were prepared for each of the 25 included papers. (J.F.P.)

For abstracts of individual papers see: 49032, 49038–49040, 49082–49087, 49100–49106, 49133, 49183, 49184, 49198, 49199, 49212, 49213, and 49283.

49063 ANGULAR ANALYSIS OF ELEMENTARY PARTICLE REACTIONS. Moussa, P.; Stora, R. (CEN de Saclay, Gif-sur-Yvette, France). pp 101-76 of Analysis of Scattering and Decay. Nikolic, M. (ed.). New York, Gordon and Breach Science Publishers Inc., 1968.

The consequences of relativistic invariance are discussed primarily following a line of reasoning due to Wigner. The formulation of symmetry laws in quantum mechanics and the basic Wigner theorem and the implications of these for collision amplitudes are described. One-particle states are discussed for arbitrary-mass and -spin particles. Two-particle states are analyzed in terms of the $1 - s$ multipole and helicity couplings, and corresponding analysis of a reactor involving two incoming and two outgoing particles. The definition of phase shifts is found to be allowed under special conditions by the unitarity of the S-matrix; and analyticity assumptions are shown to yield familiar threshold behaviors. Three-particle states for which relativistic effects are slightly more subtle than for two-particle states are examined. Helicity couplings in cascade are compared to a symmetric coupling. (44 references) (J.F.P.)

49064 SOME METHODS OF SPIN ANALYSIS IN ELEMENTARY PARTICLE PHYSICS. Koch, W. (CERN, Geneva). pp 229-331 of Analysis of Scattering and Decay. Nikolic, M. (ed.). New York, Gordon and Breach Science Publishers Inc., 1968.

The spin analysis methods covered include the quantum mechanical spin description, decay process treatments, the spin density matrix, and determination of the spin density matrix from decay processes and spin tests. All the various spin analysis methods proposed are rather similar; this is related to the fact that everything in this field follows only from angular momentum conservation and from the superposition principle in quantum mechanics. Emphasis is given to explicit calculations rather than a complete review. (43 references) (J.F.P.)

49065 KINEMATICS AND MULTIPARTICLE SYSTEMS. Nikolic, M. (ed.). Documents on Modern Physics. New York, Gordon and Breach Science Publishers Inc., 1968. 321p. $12.50.

Selected articles from the first and second sessions of the Herceg–Novi International School of Elementary Particle Physics and one article from the CERN 1964 Easter School concerning kinematics and multiparticle systems are presented. Separate abstracts are prepared for each of the 7 papers included. (C.E.S.)

For abstracts of individual papers see: 49066, 49067, 49121, 49134, 49135, 49161, and 49162.

49066 RELATIVISTIC KINEMATICS. Werbrouck, A. (Istituto Nazionale di Fisica Nucleare, Turin). pp 1-31 of Kinematics and Multiparticle Systems. Nikolic, M. (ed.). New York, Gordon and Breach Science Publishers Inc., 1968.

A review of relativistic kinematics of elementary particles is presented. Lorentz transformations, two-body collisions and decays, three- or-more-body decay processes, and spin and polarization transformations are covered. (J.F.P.)

49067 NOTES ON PHASE SPACE. Nyborg, P. (Agricultural Coll. of Norway, Vollebekk); Skjeggestad, O. pp 33-84 of Kinematics and Multiparticle Systems. Nikolic, M. (ed.). New York, Gordon and Breach Science Publishers Inc., 1968.

The derivation of phase space formulas is shown for a system of n particles in the final state, and the use of recursion relations is demonstrated in the calculation of the Lorentz-invariant phase space. The momentum spectrum of a single random particle is discussed, and the angular distribution between any two particles in the center of mass of the n particles is considered. A detailed discussion is given for three- and four-particle phase space. The deviation of the distribution of events from phase space in the presence of resonances is shown. Also the deviation from phase space in the distribution of decay product caused by the isospin, spin, and parity of a resonance is shown. Some approximations and numerical calculations are given. (28 references) (J.F.P.)

49068 CURRENT ALGEBRA MODEL BASED ON A WAVE EQUATION. Hamprecht, B. (Univ. of Chicago). Nuovo Cim., 63A: 598-608(Sept. 21, 1969).

A simple finite-component model with completely nontrivial currents is constructed, which are explicitly shown to satisfy the charge-current algebra in the infinite-momentum limit. It is argued, that the same construction applies to a large class of physically more relevant infinite-component models, which receive only negligible contributions from spacelike solutions. (auth)

49069 PROBLEMS IN PARTICLE PHYSICS. Kamal, A. N. New York, McGraw-Hill Book Company, 1966. 133p. $5.50.

The first three problems introduce the concepts of space parity, charge conjugation, and time reversal. A problem on the TCP theorem follows. Problem 5 is on the isobaric spin formalism. Problems on G-parity, symmetry laws for the $p\bar{p}$ system, and symmetries in the $K\bar{K}$ system follow. Problems 9 and 10 deal with $K \rightarrow 3\pi$ decay and neutral K-meson theory. Problems 11 and 12 are devoted to phase space calculations. Problem 13 deals with the evaluation of some branching ratios using charge independence. The $|\Delta I| = \frac{1}{2}$ rule is discussed in problem 14. This is followed by a problem on the $\pi \rightarrow \mu 1\pi \rightarrow e$ branching ratio. Problem 16 deals with certain modes of π-decay. Problem 17 introduces the principle of detailed balance. This is followed by two problems on beta decay and two-component neutrino theory. Problem 20 is on phase shift analysis of various elastic scattering processes. This is followed by an appendix on spin summation. (L.B.S.)

49070 EQUAL-TIME IRREDUCIBLE-CURRENT COMMUTATORS AND DISPERSION RELATIONS. II. Tchrakian, D. H. (Westfield Coll., London). Nuovo Cim., 63A: 793-813(Oct. 1, 1969).

A previous analysis is extended to include the use of all four spinor functions transforming like $T_{\alpha\dot{\beta}}[(1, 0) \otimes (1, 0)^*]$, $T^{\alpha\beta}[(1, 0) \otimes (0, 1)^*]$ $T^{\alpha}_{\dot{\beta}}[(0, 1) \otimes (1,0)^*]$ and $T^{\alpha\dot{\beta}}[(0, 1) \otimes (0, 1)^*]$ with respect to the homogeneous Lorentz group (H.L.G.), the spinor functions being defined by means of the irreducible currents transforming like $J(1, 0)$ and $\bar{J}(0, 1)$ with respect to the H.L.G. The dispersion sum rules are derived by use of the equal-time commutators of two currents or a current with the derivative of a current. The case where the two spin-one particles are massless is considered. The relation of this approach to the standard one is investigated. (auth)

Electromagnetic

Refer also to abstracts 49114 and 49187.

49071 (CALT-68-220) SELECTION RULES FOR DIFFRACTION DISSOCIATION. Frautschi, S. (California Inst. of Tech., Pasadena). July 1969. Contract AT(11-1)-68. 19p. Dep. CFSTI.

The possible application of several types of selection rules to diffraction dissociation is discussed. The one-photon exchange diagram for $e + A \rightarrow e + a$, $A \rightarrow B + \gamma$, $A + \bar{B} \rightarrow \gamma$, for dipole rules; Morrison's rule $\Delta P = (-1)^{\Delta J}$ for $a + b \rightarrow c + d$ inelastic interactions in which $m_a \neq m_c$; and quark model rules for the diffraction dissociation $a + b \rightarrow c + b$ are covered. (J.F.P.)

49072 (CERN-69-22) ELECTRON SCATTERING, FORM FACTORS, VECTOR MESONS. Minten, A. (European Organization for Nuclear Research, Geneva (Switzerland)). Aug. 12, 1969. 60p. Dep. CFSTI (U. S. Sales Only).

A review is given of Coulomb scattering treated in the one-photon exchange approximation; the definition, measurement, and interpretation of nucleon, pion, and electron form factors as measured by Coulomb scattering; and the formation of strongly interacting states, such as vector mesons, by annihilation of e^+e^- pairs and the relation to the crossed process, electron scattering. The basic ideas and formalisms are emphasized rather than completeness. (J.F.P.)

49073 (ORNL-4442) ANALYTIC REPRESENTATION OF PHOTONUCLEON AND PHOTOPION DIFFERENTIAL YIELDS RESULTING FROM HIGH-ENERGY ELECTRONS ($50 \leq E_0 \leq 400$ MeV) INCIDENT ON AN INFINITE COPPER TARGET. Gabriel, T. A. (Oak Ridge National Lab., Tenn.). Sept. 1969. Contract W-7405-eng-26. 31p. Dep. CFSTI.

Analytic fits of the Monte Carlo calculated differential photoparticle yields when electrons of energy 50, 100, 200, 300, and 400 MeV are incident on an infinite copper target were obtained by the method of linear least squares. For all of the above-mentioned electron energies, analytic expressions are given for the photoproton, photoneutron, and photopion differential yields in the target in the laboratory angular intervals defined by the incident electrons of 0 to 30, 30 to 60, 60 to 90, 90 to 120, 120 to 180, and 0 to 180°. (auth)

49074 (ORNL–4443) PHOTONUCLEON AND PHOTOPION PRODUCTION FROM HIGH-ENERGY (50 TO 400 MeV) ELECTRONS IN THICK COPPER TARGETS. Gabriel, T. A.; Alsmiller, R. G. Jr. (Oak Ridge National Lab., Tenn.). Sept. 1969. Contract W-7405-eng-26. 51p. Dep. CFSTI.

Electron-photon cascade calculations were carried out for high-energy electrons incident on a thick (infinite) copper target. The photon track length per unit energy from these calculations was used in conjunction with a recently developed model of photonucleon and photopion production from photon-nucleus collisions to calculate the energy and angular distributions of high-energy photonucleons and photopions produced when electrons in the energy range 50 to 400 MeV are incident on a thick copper target. (auth)

49075 (SU-1206-203) CURRENT ALGEBRA AND THE DECAY RATE OF $\eta \rightarrow 3\pi$. Yun, Suk Koo; Yamamoto, Kunio (Syracuse Univ., N. Y. Dept. of Physics). Aug. 1969. 12p. (NYO-3399-203). Dep. CFSTI.

The decay rate of $\eta \rightarrow 3\pi$ is calculated in the framework of current algebra with more relaxed limiting procedures than previously done. Instead of the pion–pole approximation, the scalar term is identified with the observed scalar-meson octet, and one particle states of axial vector, scalar and pseudoscalar mesons is used for saturation. Comparison is made with the pion-pole approximation. (auth)

49076 ELECTRIC FORM FACTOR OF THE PROTON AT SMALL MOMENTUM TRANSFERS. Arbuzov, B. A. JETP Lett. (USSR) (Engl. Transl.), 9: 443-5(June 20, 1969).

Translated from Zh. Eksp. Teor. Fiz., Pisma Redaktsiyu, 9: 705-7(June 20, 1969).

It was previously shown that discrepancies in the experimental data on the behavior of the proton form factor as small momentum transfers can be explained by assuming a small nonlinearity of the equations of electrodynamics. This assumption, where only the electric field is significant, reduces to a nonlinearity in the field Lagrangian, which leads to a change of the electron–proton interaction energy. It is shown that the change of this interaction energy can be detected by measuring the electric form factor of the proton at small momentum transfers. The Fourier transform of the effective charge distribution for electron–proton scattering is calculated, and an expression is found which is related to the proton electric form factor. (J.F.P.)

49077 HIGH-ENERGY PHOTOPRODUCTION AMPLITUDES FROM A NEW KIND OF DISPERSIVE SUM RULES. Gensini, P. (Univ., Lecce, Italy. Istituto Nazionale di Fisica Nucleare, Bari, Italy). Nuovo Cim., Lett., 2: 381-7(Sept. 11, 1969).

Dispersive techniques are applied to the study of photoproduction amplitudes. The pion and conspirator residues are evaluated and are found to be in good agreement with previous determinations. (L.B.S.)

49078 VECTOR DOMINANCE OF THE INVARIANT AMPLITUDES FOR PHOTOPRODUCTION. Meiere, F. T. (Purdue Univ., Lafayette, Ind.). Phys. Lett., 30B: 44-7(Sept. 1, 1969).

Vector dominance is expressed for the invariant amplitudes in photoproduction. Kinematics implies a strong dependence on the external mass for one of the polarized cross sections and invalidates the conventional expression. The resultant predictions require detailed analysis of vector meson data but are consistent with available experimental information. (auth)

49079 ON THE ANNIHILATION $e^+e^- \rightarrow \gamma \rightarrow \bar{N}N^*$. Alvarez-Estrada, R. F. (Junta de Energia Nuclear, Madrid); Montoto, A.; Ranada, A. F. Nuovo Cim., Lett., 2: 339-41(Sept. 11, 1969).

The cross section for the $e^+e^- \rightarrow \bar{N}N^*$ interaction is studied in terms of the Dufner–Tsai form factors describing the vertex γ-$\bar{N}$-N^*. (L.B.S.)

49080 AGREEMENT OF THE VECTOR DOMINANCE MODEL IN A COMPLETE TRANSVERSALITY SYSTEM WITH POLARIZED AND UNPOLARIZED PHOTOPRODUCTION DATA. Guiragossian, Z. G. T.; Levy, A. (Stanford Univ., Calif.). Phys. Lett., 30B: 48-52(Sept. 1, 1969).

Agreement with the vector dominance model predictions is obtained in a system where the pion produced vector mesons are described in the Donohue–Högaasen frame, generalized to account for the presence of s-wave contributions. In this system the admixture of polarizations from the element ρ^V_{10} are suppressed by a dynamical unitary transformation on the helicity frame spin density matrix. The tests are applied to pion photoproduction data by polarized and unpolarized photons; also an independent search is made for the γ-ρ coupling constant at $q^2 = 0$, yielding a value of $\gamma_\rho^2/4\pi = 0.40 \pm 0.03$. (auth)

49081 A NEW METHOD TO INVESTIGATE THE NEUTRON ELECTRIC DIPOLE MOMENT. Forte, M. (EURATOM–CCR, Ispra, Italy). Rev. Phys. Appl., 4: 241-2(June 1969).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

A new experiment to investigate the existence of a neutron electric dipole moment (EDM) is considered, based on the neutron EDM interaction with the electric dipole moments of a ferroelectric target. The changes caused in the polarization of a transmitted neutron beam and the polarization detection method are described and discussed in comparison with other experimental methods. (auth)

49082 INTRODUCTION TO THE QUARK MODEL. Kokkedee, J. J. J. (CERN, Geneva). pp 29-64 of Methods in Subnuclear Physics. Vol. III. Nikolic, M. (ed.). New York, Gordon and Breach Science Publishers Inc., 1969.

The nonrelativistic quark model is used to discuss low-energy properties of hadrons, particularly the electromagnetic properties. Also the quark model for high-energy scattering of hadrons is reviewed. (62 references) (J.F.P.)

49083 $\Delta S = 0$ WEAK INTERACTIONS, WITH EMPHASIS ON THE MUON CAPTURE. Rood, H. P. C. (Univ., Groeningen, Netherlands). pp 91-121 of Methods in Subnuclear Physics. Vol. III. Nikolic, M. (ed.). New York, Gordon and Breach Science Publishers Inc., 1969.

Weak interactions are reviewed with restriction made to leptonic and semileptonic processes. A short and superficial outline of the theory is given. The process of muon capture is given as an illustration. Also muon decay and beta and the effect of strong interactions are considered. (44 references) (J.F.P.)

49084 η DECAYS. Sutherland, D. G. (Univ. of Glasgow). pp 715-43 of Methods in Subnuclear Physics. Vol. III. Nikolic, M. (ed.). New York, Gordon and Breach Science Publishers Inc., 1969.

A study of the meson (η) along parallel lines to those used in the study of mesons (K) is presented. Only the decay modes which have been seen are discussed, although some rare decays are mentioned. The decays $\eta \rightarrow \pi^0 + 2\gamma$, $\eta \rightarrow 3\pi^0$, $\eta \rightarrow \pi^+ + \pi^- + \pi^0$, $\eta \rightarrow 2\gamma$, $\eta \rightarrow \pi^+ + \pi^- + \gamma$ are studied. (100 references) (J.F.P.)

49085 PHOTOPRODUCTION OF PSEUDOSCALAR MESONS. Rollnik, H. (Univ., Bonn). pp 615-714 of Methods in Subnuclear Physics. Vol. III. Nikolic, M. (ed.). New York, Gordon and Breach Science Publishers Inc., 1969.

Empirical knowledge and its theoretical interpretation of the photoproduction of single pseudoscalar mesons in the interactions $\gamma + p \rightarrow \pi^+(\eta) + p$, $\gamma + n \rightarrow \pi^- + p$, $\gamma + p \rightarrow \pi^0 + p$, and $\gamma + p \rightarrow K^+ + \Lambda(\Sigma^0)$ is treated. The gross structure of the photoproduction cross sections, detailed description of the isobar production, the Lagrangian formulation of the isobar model, attempts toward a dynamical theory for photoproduction via dispersion relations, and models for photo-pion production at high energies are discussed. (138 references) (J.F.P.)

49086 PHOTOPRODUCTION OF MESON AND BARYON RESONANCES. Lohrmann, E. (Deutsches Elektronen-Synchrotron, Hamburg). pp 567-613 of Methods in Subnuclear Physics. Vol. III. Nikolic, M. (ed.). New York, Gordon and Breach Science Publishers Inc., 1969.

The general properties of photoproduction are studied including the form of the general matrix element, gauge invariance, c invariance, isospin, unitary symmetry, polarized photons, electroproduction, particle models, and a survey of two-body cross sections. Special models for photoproduction are also studied including the isobar, one-meson-exchange, diffraction, and the vector dominance models. (108 references) (J.F.P.)

49087 INTRODUCTION TO CURRENT ALGEBRA. Nataf, R. (Faculte des Sciences, Orsay, France). pp 373-415 of Methods in Subnuclear Physics. Vol. III. Nikolic, M. (ed.). New York, Gordon and Breach Science Publishers Inc., 1969.

The classification of elementary particles in SU(3) symmetry is briefly studied. The structure of hadronic currents in electromagnetic and weak interactions, their structure with respect to SU(3), the CVC and PCAC hypotheses, and the commutation relations of currents and of the corresponding generalized charges are considered. (J.F.P.)

49088 REGGE-POLE MODEL WITH ABSORPTIVE CORRECTION CUTS FOR PHOTOPRODUCTION OF CHARGED PIONS. Blackmon, Maurice L. (Argonne National Lab., Ill.); Kramer, G.; Schilling, K. Nucl. Phys., B12: 495-505(1969).

A Regge-pole model for the isovector photon part of the $\pi^{\pm}$ photoproduction amplitude is reported. It is shown that Regge cuts generated by absorption can explain the forward peak in charged pion photoproduction if one uses evasive π and A_2 exchanges. The pion trajectory must be chosen rather flat. For large values of momentum transfer, the fit to the data is fair. (auth)

49089 ELECTROMAGNETIC-MASS PARADOX. Luiz, A. M. (Univ., Pisa, Italy). Nuovo Cim., Lett., 2: 429-30(Sept. 21, 1969).

A discussion is presented in order to remove the electron electromagnetic mass paradox in electrodynamics. It is shown that a purely electromagnetic electron is in full contradiction with the special theory of relativity. An entirely electromagnetic electron should be unstable due to the repulsive forces of its constituent parts. Thus since this hypothesis leads to absurd consequences, it must be abandoned. (J.F.P.)

49090 NUCLEON TRAJECTORY DEGENERACY IN BACKWARD PHOTOPRODUCTION. Barger, V.; Weiler, P. (Univ. of Wisconsin, Madison). Phys. Lett., 30B: 105-8(Sept. 15, 1969). (COO-251).

New backward scattering data on $\gamma p \to \pi^0 p$ and $\gamma p \to \pi^+ n$ are fitted with N_α, N_γ and Δ_δ Regge exchanges. An $N_\alpha - N_\gamma$ trajectory degeneracy and residues $\beta(N_\gamma) \approx 0.6\beta(N_\alpha)$ are found. The Δ_δ exchange amplitude dominates the large u, while the $N_\alpha - N_\gamma$ contribution plays a predominant role at small u. (auth)

49091 NEW MODEL OF FUNDAMENTAL PARTICLES. Wick, Gerald L. New Sci., 43: 526-7(Sept. 11, 1969).

The proposed existence by Schwinger of a new type of particle (dyon) with both magnetic and electric charges, in an attempt to explain some of the mysteries of physics, is discussed. (auth)

49092 RADIATIVE CORRECTIONS TO THE ELECTROMAGNETIC PROPERTIES OF HADRONS. Aydin, Z. Z.; Barut, A. O. (International Centre for Theoretical Physics, Trieste, Italy). Nuovo Cim., 63A: 784-93(Oct. 1, 1969).

It is shown that for particles with an anomalous magnetic moment the radiative corrections cannot be consistently treated by the perturbation theory using a nonminimal coupling. The internal structure of the particle that is responsible for the form factors must be explicitly considered. In the relativistic composite-particle model which correctly describes the complete form factors, the radiative corrections are automatically included if the current operator is suitably chosen. (auth)

49093 SPACE-TIME PICTURE OF PHOTON AND NEUTRINO SCATTERING AND ELECTROPRODUCTION CROSS SECTION ASYMPTOTICS. Ioffe, B. L. (Inst. for Theoretical and Experimental Physics, Moscow). Phys. Lett., 30B: 123-5(Sept. 15, 1969).

The problem of what longitudinal distances dominate in the process of virtual photon and the neutrino scattering on nucleons is considered. On the basis of the experimental data on the electroproduction and scattering of neutrino on nucleons, the conclusion on the dominant role of large longitudinal distances linearly increasing with the energy, is made. Asymptotic behavior of the electroproduction cross section at $\nu \to \infty$ and $q^2/\nu = \text{Const}$, is discussed proceeding from the space-time picture of the scattering. (auth)

49094 TESTS OF VECTOR-MESON DOMINANCE RELATIONS IN THE ELECTRIC BORN MODEL FOR PION PHOTOPRODUCTION. Cho, C. F.; Sakurai, J. J. (Univ. of Chicago). Phys. Lett., 30B: 119-22(Sept. 15, 1969).

Within the framework of the electric Born model and its hadronic analog the validity of various vector-meson dominance relations for single-pion photoproduction is examined. (auth)

49095 MODIFIED VECTOR DOMINANCE IN THE ALGEBRA OF VERTEX STRENGTHS. Kantorovich, A.; Ne'eman, Y. (Tel-Aviv Univ.). Phys. Lett., 30B: 111-14(Sept. 15, 1969).

The recent experimental results for $\gamma_\rho^2/4\pi(\approx 1.1)$ are explained in the framework of the algebra of vertex strengths. It is found that an extra factor $1/2$, which appears in the modified vector dominance formula for ρ photoproduction in the forward direction, is responsible for the high values. The γ_ρ coupling constant is assumed to be q^2 independent. (auth)

49096 FORM FACTORS AND VECTOR MESONS. Wilson, R. (Harvard Univ., Cambridge, Mass.). pp 47-55 of Meson Spectroscopy. Baltay, Charles (ed.). New York, W. A. Benjamin, Inc., 1968.

Some of the data and formulas for pion and nucleon form factors are discussed. (L.B.S.)

49097 ETA MESON DECAY. Baltay, C. (Columbia Univ., New York). pp 95-120 of Meson Spectroscopy. Baltay, Charles (ed.). New York, W. A. Benjamin, Inc., 1968.

The presently available experimental information about the decay of the η meson is summarized. (L.B.S.)

Weak

Refer also to abstracts 49038, 49039, and 49187.

49098 SIMPLIFIED DUAL MODEL FOR LEPTON–HADRON SCATTERING. Ademollo, M. (Univ., Florence. Istituto Nazionale di Fisica Nucleare, Florence); Del Giudice, E. Nuovo Cim., Lett., 2: 345-50(Sept. 11, 1969).

A general scheme for the current-hadron amplitudes was previously proposed, which started from a simplified model for lepton-hadron scattering. The model is discussed in detail. (L.B.S.)

49099 BRANCHING RATIO OF $K \to 3\pi$ DECAYS AND DETERMINATION OF PION SCATTERING LENGTHS. Anisovich, V. V. JETP Lett. (USSR) (Engl. Transl.), 9: 441-3(June 20, 1969).

Translated from Zh. Eksp. Teor. Fiz., Pisma Redaktsiyu, 9: 702-5(June 20, 1969).

It is possible to develop a rigorous phenomenological theory for three-particle interactions with small energy release. Within this theory, which is analogous to the Bethe–Peierls theory for two-particle reactions, meson (π) interactions in $K \to 3\pi$ decays are considered. It is found that when the scattering lengths of the mesons (π) are less than 1, the meson (π) interaction does not alter noticeably the linear formula for the experimental probabilities of $K \to 3\pi$ decays $A + B(T - \frac{1}{2}T_{max})$ for $K^+ \to 2\pi^+ + \pi^-$ decay, where A and B are constants and T is the kinetic energy of one of the mesons (π). The greatest deviation from nonlinearity in this formula occurs for the decays $K^+ \to 2\pi^0 + \pi^+ + \pi^- + \pi^0$. A comparison of the experimental meson (π) spectra and branching ratio relations for these decays with the theoretical formulas gives possible values of the meson (π) scattering lengths. (J.F.P.)

49100 TOWARDS A UNIVERSAL LAW OF WEAK INTERACTIONS. Marshak, R. E. (Univ. of Rochester, N. Y.). pp 65-90 of Methods in Subnuclear Physics. Vol. III. Nikolic, M. (ed.). New York, Gordon and Breach Science Publishers Inc., 1969.

Theoretical and experimental arguments are briefly reviewed which support the view that a successful universal theory of weak interactions is near achievement. (32 references) (J.F.P.)

49101 SPECTRA AND POLARIZATION IN $K\mu$. Jauneau, L. (Ecole Polytechnique, Paris. Laboratoire de l'Accelerateur Lineaire, Orsay, France). pp 123-85 of Methods in Subnuclear Physics. Vol. III. Nikolic, M. (ed.). New York, Gordon and Breach Science Publishers Inc., 1969.

A detailed derivation of the spectra and μ polarization in the $K^+ \to \pi^0 + \mu^+ + \nu$ decay is presented. In this way the method of the traces of products of Dirac matrices and the covariant description of the polarization of a spin-$\frac{1}{2}$ relativistic particle are studied. The Dirac spinors and weak interactions, the $K^+ \to \pi^0 + l^+ + \nu$ decay, calculation of the decay probability, the Dalitz plot density, the π - neutrino angular correlation, pion and lepton energy spectra, the $K_{\mu 3}$ and K_{e3} decay rates and branching ratio, and μ polarization are covered. (J.F.P.)

49102 NONLEPTONIC DECAYS OF HADRONS. Struminskii, B. V. (Joint Inst. for Nuclear Research, Dubna, USSR). pp 429-56 of Methods in Subnuclear Physics. Vol. III. Nikolic, M. (ed.). New York, Gordon and Breach Science Publishers Inc., 1969.

The discussion of nonleptonic decays of hadrons covers weak interaction phenomenology, SU(3) symmetry, and current algebra. (31 references) (J.F.P.)

49103 APPLICATIONS OF CURRENT ALGEBRA. d'Espagnat, B. (Faculte des Sciences, Orsay, France). pp 417-28 of Methods in Subnuclear Physics. Vol. III. Nikolic, M. (ed.). New York, Gordon and Breach Science Publishers Inc., 1969.

The applications of current algebra cover vector currents, form factors, and charge algebra, the broken symmetry of strong interactions and the nonrenormalization theorem, possible t dependence of form factors, and the relation between three- and four-body leptonic kaon decays. (J.F.P.)

49104 WEAK FORM FACTORS OF NUCLEONS. Franzinetti, C. (CERN, Geneva). pp 331-54 of Methods in Subnuclear Physics. Vol. III. Nikolic, M. (ed.). New York, Gordon and Breach Science Publishers Inc., 1969.

The review of nucleon form factors covers a description of weak interactions between leptons and hadrons, the elastic neutrino nucleon matrix element, the weak vector form factors, the electromagnetic form factors of nucleons, the weak axial vector

form factors, and a comparison with experimental results. (23 references) (J.F.P.)

49105 Λ DECAY. Conforto, G. (Univ. of Chicago). pp 313-29 of Methods in Subnuclear Physics. Vol. III. Nikolic, M. (ed.). New York, Gordon and Breach Science Publishers Inc., 1969.

The discussion of nonleptonic lambda decays covers decay asymmetry, proton polarization, final state interactions, time reversal invariance, and selection rules. The leptonic lamba decays cover the A/V ratio and time reversal invariance. (J.F.P.)

49106 SYSTEM OF NEUTRAL K MESONS. Jovanovich, J. V. (Univ. of Manitoba, Winnipeg). pp 203-43 of Methods in Subnuclear Physics. Vol. III. Nikolic, M. (ed.). New York, Gordon and Breach Science Publishers Inc., 1969.

A review is given of neutral kaons. In this review the interference phenomena are emphasized. Both theoretical and experimental results are described. (83 references) (J.F.P.)

49107 LIMITS ON DERIVATIVE COUPLINGS IN THE WEAK LEPTONIC CURRENT. Jones, P. B. (Nuclear Physics Lab., , Oxford). Nucl. Phys., B12: 561-6(1969).

The possibility is considered that the weak leptonic current contains small components which are constructed from derivatives of the lepton fields. Limits on the magnitudes of these components are calculated and it is shown that they cannot be sufficiently large to invalidate present determinations of the form factor ratio ξ in K_{l3} decay. (auth)

49108 NOTE ON THE DECAY RATES OF $_{\Lambda}H^{3}$ AND $_{\Lambda}H^{4}$. Bhamathi, G.; Prema, K. (Univ. of Madras, India). Nuovo Cim., 63A: 555-8(Sept. 21, 1969).

The decay rates and two-body decay mode branching ratios of the hypernuclei $_{\Lambda}H^{3}$ and $_{\Lambda}H^{4}$ are calculated using separable potential model wave functions. (auth)

49109 K_{l3} FORM FACTORS WITH HARD PIONS AND KAONS. Cleymans, J. (Univ., Louvain, Belg.). Nuovo Cim., 63A: 411-22 (Sept. 21, 1969).

The K_{l3} form factors are calculated using hard-pion techniques and assuming that the divergence of the strangeness-changing vector current is dominated by a hypothetical $\varkappa$-meson. The σ-terms are treated in the way suggested by the work of Gell-Mann, Renner and Oakes. An expression is obtained for $f_{-}(0)$ which is quite insensitive to a variation of $m_{\varkappa}$ between 494 MeV and 670 MeV, i.e., between the mass of the K-meson and the upper limit for the mass of the $\varkappa$-meson derived by Glashow and Weinberg. For higher values of $m_{\varkappa}$ the contribution of the $\varkappa$-meson becomes negligible. It is found that $f_{+}(0) = 0.85$ and $-0.4 < f_{-}(0) < -0.33$. These values are consistent with the inequalities proposed recently by Quinn and Bjorken and Suzuki and Horn. They are also consistent with the most recent experimental results. (auth)

49110 COMPUTATION OF K_{l4} FORM FACTORS WITH KAÒN PCAC AND VENEZIANO OR WEINBERG MODELS. Smith, C. H. Llewellyn; Pascual, R.; Yndurain, F. J. (CERN, Geneva). Nuovo Cim., 63A: 442-6(Sept. 21, 1969).

The F_1, F_2 form factors of K_{l4} decay for zero square of the momentum of the lepton pair are computed using kaon PCAC and the $K\pi$ amplitudes of Veneziano or Weinberg models. Agreement with experiment is found to be reasonable for both models. (auth)

49111 CURRENT ALBEBRAS, K_{l3} FORM FACTORS AND THE RATIO F_K/F_π. Lai, C. S.; Sugano, R. (Dalhousie Univ., Halifax, Nova Scotia). Nuovo Cim., 63A: 493-508(Sept. 21, 1969).

Using the technique of the Bjorken limit, two constraint relations for K_{l3} form factors $F_{\pm}(q^2)$ are derived. The possible forms of the form factors $F_{\pm}(q^2)$ are then determined through the Ward-Takahashi-type relation for the K_{l3} decay matrix element. Solving the Callan-Treiman relations, it is found that $F_{+}(0) = \frac{1}{2}(F_K/F_\pi + F_\pi/F_K)$ and $F_K/F_\pi = (m_\varkappa^2 - 2m_\pi^2)^{\frac{1}{2}}(m_\varkappa^2 - 2m_K^2)^{-\frac{1}{2}}$. Comparing with experiment, the following numerical values are obtained: $F_{+}(0) = 1.042$, $F_K/F_\pi = \frac{4}{3}$ and $m_\varkappa = 1038$ MeV. Recent experiment seems to indicate that $F_{+}(0)$ is indeed larger than unity. Also the K_{l3} decay parameters λ_{+}, λ_{-} and ξ and the width of the $\varkappa$-meson are calculated within the present model. (auth)

49112 NONLEPTONIC DECAY OF THE Ω^- HYPERON. Lobko, S. I. (Belorussian State Univ., Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Mat. Navuk, No. 3, 77-81(1969. (In Russian).

Using the equation for a particle with variable spin $\frac{1}{2}$ to $\frac{3}{2}$ the cross sections of the nonleptonic decay of the Ω^- hyperon were found, and the particle polarization was calculated. The spin-$\frac{3}{2}$ particle state is made to correspond with the Ω^- hyperon, and the spin-$\frac{1}{2}$ state is obtained from the decay to a fermion. (tr-auth)

49113 $K \to 3\pi$ SPECTRUM AND POLE DOMINANCE. Jacob, M.; Smith, C. H. Llewellyn; Pokorski, S. (CERN, Geneva). Nuovo Cim., 63A: 574-80(Sept. 21, 1969).

It is shown that a combination of current algebra and the pole model for $K \to 3\pi$ decay is incompatible with experiment unless off-mass-shell corrections are unexpectedly large. Without such corrections the pole terms give much too large an amplitude and do not give all the zeros required by current algebra. (auth)

49114 NONSTRONG AMPLITUDES IN A VENEZIANO-TYPE MODEL. Ademollo, M. (Harvard Univ., Cambridge, Mass.); Del Giudice, E. Nuovo Cim., 63A: 639-56(Sept. 21, 1969).

A general procedure is proposed for constructing the scattering amplitudes of hadrons with external currents. These are obtained from a representation of the N-point function for hadrons and leptons, in the lowest order of the weak constant. A model with external scalar mesons and vector currents only is considered. Current conservation is not required. The form factor, electroproduction and Compton scattering are studied, finding good analytic properties for the amplitudes. (auth)

49115 UNITARY SUM RULE AND THE TIME EVOLUTION OF NEUTRAL K MESONS. Horwitz, L. P.; Marchand, J.-P. (Univ. of Denver). Helv. Phys. Acta, 42: 801-7(1969).

The consequences of the unitary sum rule for the decay of neutral K mesons are investigated without assuming the usual semigroup property (Wigner-Weisskopf equation with constant complex Hamiltonian). A much wider class of motions in the K meson subspace then becomes possible. In particular, there may exist evolutions which do not admit any states with pure exponential decay laws. In a CP-invariant theory, however, the unitary sum rule alone implies exponential decay for the CP-eigenstates. (auth)

49116 EQUIVALENCE OF SUM RULES FOR $K_L - K_S$ DECAY. Wick, G. C. (CERN, Geneva). Phys. Lett., 30B: 126-8(Sept. 15, 1969).

The unitarity sum rules for neutral K decay obtained from an S matrix approach are shown to be completely equivalent to the sum rules of the usual approach, including the Bell–Steinberger sum rule. (auth)

49117 SOFT PIONS AND CURRENT ALGEBRAS. Berman, S. M. (Stanford Linear Accelerator Center, Calif.). pp 43-73 of Fundamental Particle Physics. Takeda, Gyo; Hara, Yasuo (eds.). New York, W. A. Benjamin, Inc., 1968.

An attempt is made to elucidate some previous soft pion results. The method uses only a single reduction of a pion where some ambiguities disappear such as the σ commutators and Schwinger terms. The analog of the Noether theorem of statistical mechanics, which is carried over to quantum field theory is mainly used. A reduction formula, the Goldberger–Treiman relation, charges, the Noether theorem, the Kroll–Ruderman theorem, the Callan–Treiman relation, and K_{e4} decays are discussed. (J.F.P.)

Strong (General)

Refer also to abstract 49169.

49118 (CALT-68-218) DUALITY. Frautschi, S. (California Inst. of Tech., Pasadena). July 1969. Contract AT(11-1)-68. 22p. Dep. CFSTI.

The discussion of duality is based on a previous approach, and various simplifications are made. A spinless reaction is considered. Proliferation and escalation are avoided by the conditions that all particles lie on linear trajectories $\alpha_i(t) = \alpha_i(0) + \alpha' i(t)$ with the same slope and that different $\alpha_i(0)$ are separated by certain allowed amounts. A general formula is given and applied to the case of some channels which communicate with the ρ and f_0 trajectories. The interaction $\pi + \pi \to \pi + \pi$ is considered. Other aspects covered are the conditions for duality, the equivalence of a certain set of exchange diagrams with a certain set of resonance diagrams, exchange degeneracy, dips, and the status of the Pomeranchon. (J.F.P.)

49119 ELEMENTARY PARTICLES. Venziano, Gabriele (Massachusetts Inst. of Tech., Cambridge). Phys. Today, 22: No. 9, 31-6(Sept. 1969).

Two complementary approaches to strong-interaction theory, the multiperipheral bootstrap and the dual-resonance models, are reviewed. The idea emerges that particles thought to be "elementary" might instead be composite, all made up of bound states of each other. (auth)

49120 CONCERNING CERTAIN CONSEQUENCES OF THE REGGE INTERACTION OF HADRONS IN THE QUARK MODEL. Laperashvili, L. V.; Mudzhavidze, I. D.; Shoikhet, V. Kh. (Inst. of Physics, Tbilisi, USSR). JETP Lett. (USSR) (Engl. Transl.), 9: 435-7(June 20, 1969).

Translated from Zh. Eksp. Teor. Fiz., Pisma Redaktsiyu, 9: 694-8(June 20, 1969).

The dependence of the residue of the Pomeranchuk pole on the

momentum-squared t in the quark model is studied. It is shown that at high energies and low values of t the dependence of the residue on t is determined mainly by the function F(t), where F is the hadron electromagnetic form factor. An analogous investigation is made for the amplitudes for the production of two reggeons on the hadron. Restriction is made to the contributions of nonenhanced diagrams. The $\pi + \pi$, N + N and other hadron-hadron interactions are considered. (J.F.P.)

49121 FINAL STATE INTERACTIONS. Wolters, G. F. (Zeeman Lab., Amsterdam). pp 267-313 of Kinematics and Multiparticle Systems. Nikolic, M. (ed.). New York, Gordon and Breach Science Publishers Inc., 1968.

The study of final-state interactions covers interactions near the threshold for production of long-lived particles, baryon isobars and the effect of final-state interactions, the Peierls mechanism, the generalized Peierls mechanism for triangle singularities, and the anomalous threshold singularity. (J.F.P.)

49122 GAUGE TRANSFORMATIONS AND GENERALIZED MULTIPOLE MOMENT OPERATORS. Lopes, J. Leite; Novello, Mario (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). Notas. Fis., Cent. Brasil. Pesqui. Fis., 15: No. 2, 23-32(1969).

A space–time dependent gauge transformation of a nonhermitian field is assumed to induce a unitary transformation in Hilbert space. This is determined by a linear functional of the gauge function which is regarded as a test function in the sense of Laurent Schwartz. It is shown that the generators of the corresponding infinitesimal transformations are multipole moment operators; the commutation rules of these operators with the field are automatically obtained and are valid for any nonhermitian field. The commutators of these moments with one another are also written down. These operators might have a meaning in the quark theory of elementary particles where a meson, which has vanishing baryonic number, might have a baryonic multipole moment since it is a set of quarks with opposite baryonic charges. (auth)

49123 DISPERSION APPROACH TO INTERFERENCE MODEL AND LOCAL DUALITY PRINCIPLE. Hsu, J. P. (Univ. of Rochester, N. Y.). Nuovo Cim., 63A: 475-82(Sept. 21, 1969).

The dispersion relations are used to obtain an interpolation formula for the amplitude which would have low-energy resonant behavior and high-energy Regge behavior. The method may be applied to both single- and multi-Regge exchange cases. A sum rule relating the Regge terms and the resonant terms is obtained, and it holds well throughout the low-energy and the intermediate-energy regions. (auth)

49124 UNIVERSALITY AND SYMMETRY PRINCIPLES IN HADRON PHYSICS. Freund, Peter G. O. (Univ. of Chicago). pp 1-23 of Fundamental Particle Physics. Takeda, Gyo; Hara, Yasuo (eds.). New York, W. A. Benjamin, Inc., 1968.

It is shown that a set of very simple symmetry and universality principles appear to be operative in strong interactions. Taken together they account for data on the strong interaction properties and the effects of strong interactions on the electromagnetic, weak, and gravitational hadron interactions. (J.F.P.)

49125 RELATIVISTIC VERSION OF THE SCHIFF LARGE-ANGLE FORMULA. Martinis, M. E.; Dadic, I. (Rudjer Boskovic Inst., Zagreb). Nuovo Cim., 63A: 721-42(Oct. 1, 1969).

Within the formalism of multiple scattering, using the Sudakov variables, the derivation of the Schiff large-angle formula is presented. The formula is then used to explain the possible mechanism responsible for the change of regime of the exponential fall-off of the differential cross section at large angles, i.e., for $|t| = |t_1| \sim 7$ (GeV/c)^2. Another approach, similar to that of Glauber but which is superior to it for large angles, is considered in detail. It gives the exponential fall-off of the elastic differential cross section for small, intermediate, and large angles all in one equation. Moreover, it agrees with the Orear empirical fit when the scattering angle is close to 90°. (auth)

49126 BARYON BOOTSTRAP IN W_3 SYMMETRY. Schillaci, M. E. (Brandeis Univ., Waltham, Mass. Los Alamos Scientific Lab., N. Mex.). Nuovo Cim., 63A: 761-83(Oct. 1, 1969).

Using a Bethe–Salpeter bootstrap model, it is shown that the $\frac{1}{2}^+$ baryons and the $\frac{1}{2}^+$ meson–baryon resonances form a reciprocal bootstrap in W_3 symmetry. The $\frac{1}{2}^+$ baryons are assigned to a nine-dimensional representation of W_3 which contains the usual octet and a singlet of the SU_3 subgroup. The $\frac{1}{2}^+$ resonances are assigned to a 45-dimensional representation which contains, in addition to the usual decuplet, an octet and a 27-plet. Coupling-constant ratios and the mass difference between the $\frac{1}{2}^+$ nonet and $\frac{1}{2}^+$ 45-plet are self-consistently determined. In a separate calculation, symmetry-breaking interactions are studied which lead to a parametrization of the masses of the SU_3 components of the nonet and 45-plet. The splitting of the ninth baryon from the octet is found to increase very rapidly as W_3 is broken, while the mass of the 27-plet of resonances increases much less rapidly than that of the resonance octet. Finally, decay rates of some possible candidates for the 27-plet of resonances are calculated and compared to experimental rates. (auth)

49127 NON STRANGE BOSONS. Cline, D. (Univ. of Wisconsin, Madison). pp 391-409 of Meson Spectroscopy. Baltay, Charles (ed.). New York, W. A. Benjamin, Inc., 1968.

Some of the evidence for bosons of mass $>2M_N$ obtained from production experiments are first reviewed. The present evidence concerning direct channel resonance structure in the $\bar{p}p$ system is then discussed. (L.B.S.)

Strong (Baryon No. = 0)

Refer also to abstracts 49196, 49201, 49212, and 49216.

49128 (ISS–69/25) FACTORIZATION AND DEGENERACY OF THE HADRON SPECTRUM IN VENEZIANO MODEL. Cassandro, M.; Maiani, L. (Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica). June 24, 1969. 9p. Dep. CFSTI (U. S. Sales Only).

The factorization properties of the Veneziano amplitude for the two body scattering of spinless particles are investigated. Consistency is found only if one allows for degenerate daughter levels. In the scattering of particles belonging to the same SU(3) multiplet, strict factorization is obeyed at all daughter poles, to first order in mass differences, due to the relation: $\alpha_\varphi + \alpha_\varphi = 2\alpha_{K^*}$. This is interpreted as a nonrenormalization property (from the SU(3) symmetric values) of the coupling constants of the degenerate resonances. (auth)

49129 REMARKS ON DOUBLE POLES AND NONEXPONENTIAL DECAYS. Lokajicek, M. V. (Joint Inst. of Nuclear Research, Dubna, USSR). Czech. J. Phys., 19: 1067-75(1969).

The model of an unstable particle with two internal states, which are able to change from one into the other, is analyzed with the help of a previous formalism outlined generally. This formalism is developed further. (auth)

49130 CROSSING CONSTRAINTS ON $\pi\pi$ PARTIAL WAVE AMPLITUDES. Roskies, R. (CERN, Geneva). Contract AT-(30-1)-2726. Phys. Lett., 30B: 42-3(Sept. 1, 1969).

New constraints on the $\pi\pi$ partial wave amplitudes below threshold, derived on the basis of crossing symmetry and isospin invariance alone, are given. (auth)

49131 CONTACT TERM FOR $\omega \rightarrow 3\pi$ DECAY IN THE VENEZIANO MODEL. Visinescu, Mihai (Inst. for Atomic Physics, Bucharest). Progr. Theor. Phys. (Kyoto), 42: 136-8(July 1969).

The Veneziano model is used for an estimation of the contact term contained in the reduced diagonalized four-point function for $\omega \rightarrow 3\pi$ decay. The contribution of the contact term is found to be small. This indicates that the major part of the decay amplitude is given by the meson (φ) pole. (J.F.P.)

49132 DETERMINATION OF THE LOW ENERGY PION–PION SCATTERING. Castoldi, P. (Univ. Libre, Brussels). Nucl. Phys., B12: 567-72(1969).

The dispersion relation for forward $\pi^+\pi^0$ elastic scattering is solved by imposing consistency in the low-energy region between input cross section and output cross section. The I = 2, S-partial wave amplitude has a scattering length $a_2 \approx 0.26$ and vanishes at $\omega \approx 457$ MeV. The model proposed by Wanders and collaborators is used to test this behavior: no serious incompatibility with the conditions of Martin is found if the I = 0. S-partial wave amplitude has a scattering length $a_0 \approx 0.8$ and vanishes at $s \approx -2.4$. (auth)

49133 NEUTRAL DECAYS OF BOSON RESONANCES. Goldschmidt-Clermont, Y. (CERN, Geneva). pp 777-814 of Methods in Subnuclear Physics. Vol. III. Nikolic, M. (ed.). New York, Gordon and Breach Science Publishers Inc., 1969.

In the study of neutral decays of boson resonances a limited number of representative experiments are reviewed emphasizing experimental techniques and procedures not extensively reviewed previously. The decay modes which do not violate C or CP are discussed. The decays of vector bosons and neutral decays of the meson (η) are considered. (65 references) (J.F.P.)

49134 MULTI-PION SYSTEMS. DECAY OF TWO- AND THREE-PION RESONANCES. Svensson, B. E. Y. (Univ. of Lund, Sweden). pp 115-83 of Kinematics and Multiparticle Systems. Nikolic, M. (ed.). New York, Gordon and Breach Science Publishers Inc., 1968.

A complete theoretical treatment is given for the decay of two- and three-pion resonances, assuming that this decay obeys all conservation laws of the strong interaction. The presentation is given

from an experimental point of view. The angular analysis in the decay is emphasized. The production and decay of an arbitrary unstable particle are also described. (J.F.P.)

49135 PROTONIUM ANNIHILATION. Vandermeulen, J. (Univ., Liege). pp 185-220 of Kinematics and Multiparticle Systems. Nikolic, M. (ed.). New York, Gordon and Breach Science Publishers Inc., 1968.

Results obtained in the study of proton–antiproton annihilation at rest in liquid hydrogen are reviewed. Capture for annihilation from S-states of the protonium is discussed including the moderation and absorption of slow, negative, strongly interacting particles in liquid hydrogen and the direct test of S capture performed in a particular annihilation channel. Several annihilation modes are examined in detail, and methods used for the identification of various channels are introduced. (63 references) (J.F.P.)

49136 EVIDENCE FOR A LOW-ENERGY S-WAVE $\pi-\pi$ INTERACTION AND A POSSIBLE DOUBLY CHARGED DIBARYON ENHANCEMENT. Hall, J. H.; Murray, T. A.; Riddiford, L. (Univ. of Birmingham, Eng.). Nucl. Phys., B12: 573-85(1969).

The reaction $N + N \rightarrow d + 2\pi$ was studied at an energy of 991 MeV using a missing mass spectrometer. The results are consistent with a recent phase-shift analysis of the $I = 0$ $\pi-\pi$ interaction, showing structure not evident in earlier experiments. In addition, possible evidence for a di-baryon resonance of mass 2.10 GeV/c^2 was obtained, in support of earlier evidence for such a phenomenon. (auth)

49137 ANALYTIC EXTRAPOLATION OF FORM FACTORS AND SCATTERING AMPLITUDES. II. EXTRAPOLATION UP TO THE BOUNDARY. Pisut, J. (Comenius Univ., Bratislava); Presnajder, P.; Fischer, J. Nucl. Phys., B12: 586-98(1969).

A method for extrapolation of scattering amplitudes and form factors up to the boundary of the analyticity region is proposed. The method uses in a substantial way a class of focusation functions which are analytic in the analyticity region of the amplitude except for a cut on the physical region where the data are given. On the boundary of the analyticity region focusation functions are real and large only on a prechosen arc. Consequently, as a result of extrapolation, not the value of the extrapolated function in a particular point on the boundary but the averaged value over a finite arc is obtained. It is shown that this type of extrapolation increases significantly the reliability and stability of practical extrapolations. A possible way towards the applicability of statistical concepts to results of extrapolation is briefly mentioned. To illustrate the concepts introduced some of the ambiguities arising in the determination of pion-pion S-waves from dispersion relations are discussed. (L.B.S.)

49138 MANIFESTLY CROSSING-INVARIANT PARAMETRIZATION OF n-MESON AMPLITUDE. Koba, Ziro; Nielsen, Holger Bech (Univ. of Copenhagen). Nucl. Phys., B12: 517-36 (1969).

Utilizing the geometric property (of being certain anharmonic ratios) of the variables u, which are "conjugate" to the Regge trajectories in the generalized Veneziano amplitude for the n-meson reaction, an integral representation of the latter is constructed in such a way that all the external mesons appear on an equal footing and thus all the requirements of crossing symmetry are fulfilled. A precise mathematical meaning can be ascribed to our integral representation. (auth)

49139 SEARCH FOR GHOSTS IN VENEZIANO'S MODEL. Wagner, F. (CERN, Geneva). Nuovo Cim., 63A: 393-9(Sept. 21, 1969).

The absence of ghost states in Veneziano's crossing symmetric Regge formula is shown to imply universal slopes. For certain trajectories it has been verified numerically that there are no ghosts among all the daughters up to the 50th recurrence. The asymptotic behavior in the impact parameter was also investigated. (auth)

49140 PARITY CONSTRAINTS ON REACTION AMPLITUDES. Freund, P. G. O.; Schonberg, E.; Waltz, R. (Univ. of Chicago). Nuovo Cim., 63A: 447-50(Sept. 21, 1969).

A method to avoid parity doubling in Veneziano-type models for scattering of particles with spin is presented. Parity constraints on N-particle amplitudes are discussed. (auth)

49141 RIGOROUS LOWER BOUNDS TO $T = 0$ AND $T = 2$ $\pi-\pi$ s-WAVE SCATTERING LENGTHS. Common, A. K. (CERN, Geneva). Nuovo Cim., 63A: 451-67(Sept. 21, 1969).

Lower bounds are obtained for $T = 0$, 2 s-wave π-π scattering lengths from unitarity, the nonexistence of a π-π bound state, and a certain amount of analyticity for the π-π scattering amplitudes. This analyticity and the corresponding twice-subtracted dispersion relations are consequences of axiomatic field theory. (auth)

49142 MESON SPECTROSCOPY. A Collection of Articles. Baltay, Charles; Rosenfeld, Arthur H. (eds.). New York, W. A. Benjamin, Inc., 1968. 598p.

Twenty-three papers are presented, representing a comprehensive review of recent developments in the field of meson spectroscopy. Separate abstracts were prepared for fourteen. The volume is loosely based on a series of papers presented at the Conference on Meson Spectroscopy held at the University of Pennsylvania, Philadelphia, April 26–27, 1969, but it is not intended to represent the conference proceedings. Nine papers were previously abstracted for NSA and appeared as 22: 39236, 41730, 41743, 41803, 41807, 46423, 50369, 52972, and 23: 3711. (L.B.S.)

For abstracts of individual papers see: 47842, 47843, 49058, 49096, 49097, 49127, and 49143–49150.

49143 LOW ENERGY $\pi\pi$ SCATTERING. Ross, M. (Univ. of Michigan, Ann Arbor). pp. 29-39 of Meson Spectroscopy. Baltay, Charles (ed.). New York, W. A. Benjamin, Inc., 1968.

Some difficulties associated with the extraction of $\pi\pi$ phase shifts at low $\pi\pi$ mass from $\pi N \rightarrow 2\pi N$ by an empirical extrapolation are pointed out. Improved procedures for performing an extrapolation of moments are suggested. (L.B.S.)

49144 THE SIGN OF THE $S = T = O$ $\pi\pi$ SCATTERING PHASE SHIFT. Jones, Lawrence W. (Univ. of Michigan, Ann Arbor). pp 41-5 of Meson Spectroscopy. Baltay, Charles (ed.). New York, W. A. Benjamin, Inc., 1968.

It is pointed out that in bubble-chamber analyses based on $\pi^-p \rightarrow \pi^+\pi^-n$ interactions, a possible bias of the forward–backward asymmetry of the $\pi\pi$ scattering leads to an erroneous determination of the sign of the δ_0^0 phase shift. (L.B.S.)

49145 VECTOR MESON COUPLING CONSTANTS. Zachariasen, F. (California Inst. of Tech., Pasadena). pp 57-75 of Meson Spectroscopy. Baltay, Charles (ed.). New York, W. A. Benjamin, Inc., 1968.

The application of the vector dominance model to the pion electromagnetic form factor is first discussed. The experimental situation regarding the γ_ρ, $\gamma_{\rho\pi\pi}$, γ_ϕ, and γ_ω coupling constants is reviewed. (L.B.S.)

49146 Kπ SCATTERING AND NORMAL PARITY K*'s. Schlein, Peter E. (Univ. of California, Los Angeles). pp 161-207 of Meson Spectroscopy. Baltay, Charles (ed.). New York, W. A. Benjamin, Inc., 1968.

The study of meson–meson scattering is reviewed from the standpoint of peripherally produced mesons resulting from scattering of the beam particle on a virtual π in the cloud around a target nucleon. Particular emphasis is given to the state of knowledge of the Kπ interaction and various problems associated with this type of analysis. (L.B.S.)

49147 COMPILED EVIDENCE FOR A SPLITTING OF THE A2 MESON. Kienzle, W. (CERN, Geneva). pp 265-95 of Meson Spectroscopy. Baltay, Charles (ed.). New York, W. A. Benjamin, Inc., 1968.

A summary is given of the present knowledge about the A_2 mass spectrum. Evidence is presented for a two-peak structure from missing-mass spectrometer studies at CERN, boson spectrometer studies at CERN, and bubble-chamber data from BNL. Speculative interpretations of the splitting are also given. (L.B.S.)

49148 DOUBLE POLES. Goldhaber, Alfred S. (State Univ. of New York, Stony Brook). pp 297-302 of Meson Spectroscopy. Baltay, Charles (ed.). New York, W. A. Benjamin, Inc., 1968.

The possibility that the symmetrical split peak of the A_2 comes from a coherent effect in a state of definite spin–parity is considered. It is shown that the symmetrical split peak requires more than the existence of a double pole in the S-matrix, namely the dominance of a single channel of the resonant system. (L.B.S.)

49149 STRUCTURE IN THE ANTINUCLEON–NUCLEON TOTAL CROSS SECTIONS IN THE REGIONS OF ENERGY ABOVE 2M. Michael, D. (Brookhaven National Lab., Upton, N. Y.). pp 411-18 of Meson Spectroscopy. Baltay, Charles (ed.). New York, W. A. Benjamin, Inc., 1968.

The resonance structures observed in the antinucleon–nucleon total cross sections near 1.3 and 1.8 GeV/c are discussed in detail. Two possible interpretations of these structures are given; either they are the result of the formation of boson resonances, or they are the result of threshold effects. (L.B.S.)

49150 MESONIC RESONANCE STATES. Dalitz, R. H. (Oxford Univ.). pp 497-584 of Meson Spectroscopy. Baltay, Charles (ed.). New York, W. A. Benjamin, Inc., 1968.

The classification, properties, and interactions of meson states are discussed in terms of the nonrelativistic quark model. Information on the observed mesonic nonets is reviewed. Higher mesonic states are also discussed. (L.B.S.)

49151 PROPERTIES OF LEGENDRE EXPANSIONS RELATED TO SERIES OF STIELTJES AND APPLICATIONS TO $\pi-\pi$ SCATTERING. Common, A. K. (CERN, Geneva). Nuovo Cim., 63A: 863-91(Oct. 1, 1969).

Legendre expansions whose coefficients are those of a series of Stieltjes are considered. It is shown that the analyticity domain of a function defined by such an expansion is the cut plane and that sequences of approximants may be defined which converge to the function in this domain, with each approximant determined from a finite number of coefficients in the expansion. These approximants are related to the Padé approximants of the corresponding series of Stieltjes. It is shown that if the coefficients satisfy a "Froissart–Gribov" type representation with positive weight, then they are also coefficients of series of Stieltjes. It follows that the above results may be applied to the $\pi-\pi$ scattering amplitude A(s,t) for certain states when $0 \leq s < 4$. In particular the approximation of A(s,t) is the complex t-plane, when only the first few partial waves $a_l(s)$ are known, is discussed and the interpolation of the $a_l(s)$ for noninteger l is also considered. Another consequence is that the $a_l(s)$ satisfy an infinite set of determinantal inequalities when $0 \leq s < 4$. (auth)

Strong (Baryon No. = 1)

Refer also to abstracts 49054, 49058, 49143, and 49216.

49152 (S-T-324) PHENOMENOLOGY BASED ON POINCARE GROUP ANALYSIS. Thorland, Edward Owen (Ames Lab., Iowa). Aug. 1969. Contract W-7405-eng-82. 133p. Dep. CFSTI. Thesis.

A review is made of the Poincaré group and (via little group theory) of its irreducible unitary representations, with special emphasis on the space-like and continuous spin light-like cases. Several Clebsch-Gordan coefficients are derived (in a general frame) and are written in such a manner that their symmetry properties are easily obtained. The Clebsch-Gordan coefficients are applied in a general theory of partial wave expansions which places cross channel expansions on a level with the usual direct-channel expansion. A possible connection between the space-like crossed expansion and Regge theory is investigated in some detail. The time-like and light-like cross-channel (u channel) expansions for pion-nucleon elastic scattering are carefully investigated, particularly near u = 0. CERN phase-shift data is used to numerically perform the cross-channel partial wave analysis. A simple behavior is observed in the u = 0 amplitudes, and arguments are given which demonstrate that one is in fact measuring, in a very natural way, the pion-nucleon interaction distance with the u = 0 expansion. (auth)

49153 (TF-69-24) QUASI-INDEPENDENT QUARK MODEL: ADDITIVITY AND FACTORIZABILITY HYPOTHESES. Kobushkin, A. P.; Shelest, V. P. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1969. 15p. Dep. CFSTI (U. S. Sales Only).

A dynamical approach to the problem of hadron scattering is proposed in the model of the quasi-independent quark. Toward this end the unitary structure of the effective scattering potential is studied. It is shown that in this model the factorizability hypothesis resolves itself into additivity of the quark amplitudes. Relations for the elastic hadron scattering at large angles are derived. They are in good agreement with experiment. (auth)

49154 ON THE SIGN OF cos θ AT THE BRANCH POINTS OF A PARTIAL WAVE AMPLITUDE IN THE s PLANE. Blazek, M. (Inst. of Physics, Bratislava). Czech. J. Phys., 19: 1053-60(1969).

The sign of the cosine of the scattering angle, cos θ, at the branch points of a relativistic two-body partial wave amplitude with arbitrary masses in the complex s-plane is determined. The results yield that as to the top s-sheet, the sign of cos θ is the same at the complex conjugated branch points which lie off the real s-axis, and cos θ changes sign at the (direct channel) thresholds. The difference between the elastic and inelastic cases is emphasized. It is pointed out that in certain physical energy ranges, for some collisions (e.g., $\pi + N \rightarrow \pi + N$), the directions near the backward direction can be considered as the most important ones, while for several other collisions (e.g., $\pi + N \rightarrow \rho + N$) the directions into the forward hemisphere have the strongest influence. (auth)

49155 ASYMPTOTIC EQUALITIES OF MULTIPRODUCTION CROSS-SECTIONS AT COLLISION OF PARTICLES WITH SPIN. Nguyen Ngoc Thuan (Joint Inst. for Nuclear Research, Dubna, USSR). Ukr. Fiz. Zh., 14: 826-32(May 1969). (In Russian).

Asymptotic equalities are obtained of multiproduction process cross sections integrated by some variables for meson-baryon and baryon-baryon collisions. To check these ratios it is not necessary to investigate in detail each process of multiproduction. (auth)

49156 STRUCTURE OF PROTONS AND NEUTRONS. Alvarez-Estrada, R. Fernandez. Energ. Nucl. (Madrid), 13: 133-42(Mar.-Apr. 1969). (In Spanish).

An attempt is made to explain simply what is understood presently by proton and neutron structure, how they are studied, and the present state of theoretical and experimental knowledge on them. The topics discussed are the problem of magnetic moments, intuitive image of nucleons, the inelastic electron-proton scattering, elastic electron-nucleon scattering, experimental apparatus, description of the data for the four form factors, and introduction to theories on form factors. (J.S.R.)

49157 NEW SUM RULES FOR THE VACUUM REGGE-POLE PARAMETERS. Ng, P. H.; Queen, N. M. (Univ. of Birmingham, Eng.). Nuovo Cim., Lett., 2: 360-2(Sept. 11, 1969).

New sum rules for πN and KN scattering are presented, which partially overcome the defects of conventional sum rules. The sum rules provide two independent relations between the four Regge-pole parameters which are assumed to describe the asymptotic behavior of either of the amplitudes $f_{\pi N}^{(+)}$ or $f_{KN}^{(+)}$. The sum rules are used to calculate the πN and KN residues $\beta_l^{(\pi N)}$ and $\beta_l^{(KN)}$ (l = P,P') as functions of α_p and $\alpha_{p'}$. (L.B.S.)

49158 RESONANCE PEAKS SIMULATED BY FINAL-STATE EFFECTS. Kuhn, D. (Univ., Innsbruck); Majerotto, W.; Otter, G. Nuovo Cim., Lett., 2: 351-3(Sept. 11, 1969).

The effect of final-state interactions near threshold on the production of resonance peaks is studied in the reactions $K^-p \rightarrow \rho\rho K$ ($pK^*\pi$) for the production of K*(1320). The Deck effect is also considered. (L.B.S.)

49159 CONSIDERATIONS ON A CLASS OF QUANTUM FIELDS, WITH APPLICATION TO PION PHOTOPRODUCTION. Raszillier, Ioan (Institutul de Fizica, Bucharest). Stud. Cercet. Fiz., 21: 261-98(1969). (In Rumanian).

The topics covered are free fields including one-particle states, and Dirac, tensor, and Rarita–Schwinger fields; spectral representations covering representations for tensor and Rarita–Schwinger fields, and invariance requirements, supplementary conditions, and the spin-3/2 Rarita–Schwinger field. Also discussed are pionic and electromagnetic form factors, pion photoproduction on nucleons covering the kinematics, multipole amplitudes, and the Gourdin–Salin model. (J.F.P.)

49160 RELATIVISTICALLY COVARIANT EFFECTIVE QUARK MODEL OF ELEMENTARY PARTICLES. Shelest, V. P. Atti Accad. Naz. Lincei, Rend., Cl. Sci. Fis., Mat. Natur., 326-9(Nov. 1968).

A quasi-independent quark model is constructed. In this model baryons are considered as strongly bound states of quarks and mesons are considered as strongly bound states of quarks and antiquarks. Quarks and antiquarks have very large masses M, which account for most of the interaction within hadrons. This strong interaction constitutes a self-consistent field, and quarks with effective masses m < M move in this field in a quasi-independent way. There is also a residual interaction between the quasi-independent quarks, which for some purpose is completely switched off. Calculations are performed for baryons. (J.F.P.)

49161 KINEMATICS OF RESONANCE PRODUCTION. Czyzewski, O. (Inst. of Nuclear Research, Krakow). pp 85-113 of Kinematics and Multiparticle Systems. Nikolic, M. (ed.). New York, Gordon and Breach Science Publishers Inc., 1968.

The kinematics of resonance production are discussed for various $\pi^+ + p$ and $\bar{p} + p$ interactions. The three-body final state is considered covering the boundary of a Dalitz plot and correlations between masses and decay angular distributions. The Chew–Low plot is also considered covering the boundary of a Chew–Low plot and similar graphs. Also the three-body subset of a larger system is discussed for the symmetric and general cases. (J.F.P.)

49162 INTERFERENCE OF RESONANCES. Wolters, G. F. (Zeeman Lab., Amsterdam). pp 221-66 of Kinematics and Multiparticle Systems. Nikolic, M. (ed.). New York, Gordon and Breach Science Publishers Inc., 1968.

The discussion of resonance interference covers the recapitulation of some elements of the helicity formalism as applied to resonance decay, elastic resonance excitation and interference effects, and interference in the simultaneous production of two resonances. (J.F.P.)

49163 SOLUTION OF THE LEON–BETHE MODEL FOR THE DAY–SNOW–SUCHER EFFECT BY DYNAMICAL GROUP METHODS. Vermeulen, J.-L. (Laboratoire de Physique Theorique

et Hautes Energies, Orsay, France). Nucl. Phys., B12: 506-16 (1969).

The Leon–Bethe model for the Day–Snow–Sucher mixing effect of orbital states in the annihilation of negative pions at rest in liquid hydrogen is solved by a method similar to the one of Flamand. Instead of the Lie algebra of the group SU(2) there appears here the algebra of the group E(2). The results of the two methods justify some approximations used to solve the model. The capture time appears to be compatible with the experimental values. (auth)

49164 K^+p BACKWARD SCATTERING FROM THE VENEZIANO MODEL. Pretzl, K. P.; Igi, K. (CERN, Geneva). Nuovo Cim., 63A: 609-16(Sept. 21, 1969).

The residue functions of the leading $Y_0^+(\Lambda_\alpha, \Lambda_\gamma)$ and $Y_1^+(\Sigma_\delta, \Sigma_\beta)$ trajectories in the backward K^+p scattering are parametrized according to the Veneziano model, consistent with the absence of the particles which are not found in nature. A best fit is obtained for K^+p backward scattering data from 2.0 to 7.0 GeV/c. The extrapolated residues agree approximately with experimental Y_0^+ and Y_1^+ widths. (auth)

49165 FIXED-BRANCH-POINT MODEL FOR PION–NUCLEON DIFFRACTION SCATTERING. Friedman, D. D. (Univ. of Chicago). Nuovo Cim., 63A: 483-92(Sept. 21, 1969).

A model for high-energy πp scattering is considered in which the positive-signature amplitude is assumed to contain a fixed square-root branch point in the complex angular-momentum plane. The model contains no Pomeranchukon. The highest Regge pole is assumed to be the P′ traejectory. Under various assumptions about the intersect of the pole traejectory and the weight along the cut, the model is fitted to available data on total cross sections, the phase of the forward-scattering amplitude, and also to the Igi sum rule. Under various physically plausible assumptions a fit exists to within 0.2 mb for the cross sections, 15% for the real part of the amplitude, and 0.5 mb for the sum rule. The model can be distinguished from other Regge models at energies above 50 GeV. (auth)

49166 LORENTZ-POLE ANALYSIS OF THE REACTION $K^+ p \rightarrow K^0\Delta^{++}$. Samiullah, M.; Rao, A. Srinivas (Osmania Univ., Hyderabad, Pakistan). Nuovo Cim., Lett., 2: 456-8(Sept. 21, 1969).

The high-energy behavior of the interaction $K^+ + p \rightarrow K^0 + \Delta^{++}$ was studied in terms of a previous 0(3,1) partial wave analysis. This analysis confirms the previous conclusion that the major contribution to the differential cross section is from the helicity-flip amplitudes and from the A_2 pole. It is also found that the dominant amplitudes for these interactions are $\langle O\ 3/2|T|O\ 1/2\rangle$ and $\langle O\ 1/2|T|O\ 1/2\rangle$ and that only a small t dependence of the A_2 residue function is necessary to obtain a good fit. (J.F.P.)

49167 COMMENTS ON ω-LIKE REGGE-POLE EXCHANGE IN KN SCATTERING. Lusignoli, M. (Univ., Aquila, Italy. Univ., Rome); Odorico, R.; Restignoli, M.; Violini, G. Nuovo Cim., Lett., 2: 419-23(Sept. 21, 1969).

The finite-energy sum rules for K + N scattering are re-evaluated, using continuous moment sum rules and an improved set of phase shifts, in order to estimate errors in a previous study of the Regge-pole structure of K + N scattering. It is found that the quality of Kp phase shifts available does not suffice for drawing reliable conclusions about the ω-flip contribution to KN scattering. There is no reliable evidence for Im B_ω being appreciably different from zero and negative near $t \simeq -0.5$ $(GeV)^2$. (J.F.P.)

49168 THREE-BODY INTERACTIONS ($\bar{N}NN$) IN ANTI-PROTON-DEUTERON ANNIHILATION AT REST. Bizzarri, R. (Univ., Rome. Istituto Nazionale di Fisica Nucleare, Rome); Ciapetti, G.; Dore, U.; (and others). Nuovo Cim., Lett., 2: 431-6 (Sept. 21, 1969).

The observation of events inconsistent with a simple impulse model because they are of the types $\bar{p} + d \rightarrow \pi^- + p$ or $\bar{p} + d \rightarrow \Lambda^0 + K + n\pi$ is reported. These interactions took place at rest in a bubble chamber. It is found that a large fraction cannot be described by considering the possibility of rescattering of one of the annihilation products on the residual nucleon, but they must be considered as the result of an effective three-body initial-state interaction. (J.F.P.)

49169 QUARK MODEL FOR FORBIDDEN PEAKS. Bialas, A. (CERN, Geneva); Zalewski, K. Phys. Lett., 30B: 109-10 (Sept. 15, 1969).

A quark model for the forward peaks in the processes forbidden for non-exotic t channel exchanges is proposed. The model gives strong predictions for the decay distributions polarization of the baryon resonances produced in these processes. (auth)

49170 COMMENTS ON THE REGGEIZED ABSORPTION AND MULTIPLE-SCATTERING MODELS. Rivers, R. J. (Univ. of Chicago). Nuovo Cim., 63A: 697-720(Oct. 1, 1969).

The assumptions under which the Reggeized absorption and elastic-multiple-scattering models can be said to unitarize a nonunitary Regge-pole amplitude are examined. It is shown that one of these assumptions, the random-phase assumption, is poorly satisfied for πN charge-exchange scattering. (auth)

Strong (Baryon No. ≥ 2)

Refer also to abstracts 49046, 49136, and 49212.

49171 (AD–690395) REPULSIVE CORE AND INTERACTION ENERGY IN PROTON–PROTON SCATTERING. Libby, L. Marshall (RAND Corp., Santa Monica, Calif.). June 1969. 11p. (P–4096). CFSTI.

The interaction energy between two protons is computed from high energy elastic cross sections at 60 and 90 degrees, using an optical model. The repulsive core becomes important for separation less than approximately 0.3 Fermi. The exponential dependence of high energy cross sections is shown to predict repulsive forces at small separation. (auth)

49172 (ORNL-tr-2200) INELASTIC INTERACTIONS OF HIGH-ENERGY PROTONS WITH ATOMIC NUCLEI. Barashenkov, V. S.; Gudima, K. K.; Toneev, V. D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). Translated for Oak Ridge National Lab., Tenn., from report JINR–P2-4402. 15p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 23: 30765.

49173 (SLAC-Trans–98) MUON PAIR PRODUCTION IN STRONG INTERACTIONS AND THE ASYMPTOTIC SUM RULES. Matveev, V. A.; Muradyan, R. M.; Tavkhelidze, A. N. (Joint Inst. for Nuclear Research, Dubna (USSR)). Translated by T. Watt for Stanford Linear Accelerator Center, Calif., from report JINR–P2-4543. 27p. Dep. CFSTI.

Meson (μ) pair production for highly inelastic interactions between a hadron and a proton at high energies which results in the production of a meson (μ) pair and a system of hadrons is studied. It is shown that at high energies and momentum transfers the form factors for this process are related to the matric elements of equal-time electromagnetic current commutators. The asymptotic sum rules obtained can be used as a basis for verifying the structure of the electromagnetic hadron current. The predictions of the quark current algebra and field algebra for the muon polarization turn out to be qualitatively different. Studies of meson (μ) polarization in this process are also essential for the analysis of experiments using polarized muon detection at large angles. (J.G.P.)

49174 (TRI-69-4) POLARIZATION MEASUREMENTS FOR $pp \rightarrow \pi^+D$. Beder, D. S. (TRI-Univ. Meson Facility, Vancouver, (British Columbia)). Apr. 1969. 16p. Dep. CFSTI (U. S. Sales Only).

How polarization experiments on $pp \rightarrow \pi d$ can provide information on the transition amplitudes relevant near the reaction threshold energy is discussed. (auth)

49175 THERMONUCLEAR PION PRODUCTION AND HIGH TEMPERATURE STARS. Falla, D. F.; Sale, R. G. (University Coll. of Wales, Aberystwyth). Nature (London), 223: 725-6 (Aug. 16, 1969).

Pions may be produced in thermonuclear interactions between nucleons in material at $\gtrsim 10^{10}$ K., and pion production followed by secondary interaction is among the many processes contributing to the statistical equilibrium of a high temperature astrophysical system. It is emphasized, however, that charged pions undergo decay as an alternative to secondary interaction, producing μ-neutrinos (ν_μ), and if these neutrinos have a high escape probability their emission may cause an appreciable energy loss from the system. The rate of pion production is computed for proton–proton interactions in hydrogen at two different temperatures (5×10^{10} and 10^{11} K), the relative probability of charged pion decay is estimated, and the relevance of this type of neutrino production for a particular class of massive star with a high-temperature and -density interior is discussed. Although the calculations apply to proton–proton interactions in hydrogen, the results obtained should be independent of stellar composition. The figure obtained for ν_μ production is infinitesimally small in comparison with the rate at which electron-neutrinos are produced, for example by electron-positron pair annihilation. Furthermore it has been shown for neutron stars that while at $T \approx 10^{12}$K meson pair production is significant, even at $T \approx 10^{11}$K the ν_μ energy production rate resulting from pion decay is $\sim 10^{31}$ erg/cm^3/sec. It is concluded that, in comparison with other neutrino processes, ν_μ production from pions produced in thermonuclear reactions has a negligible effect on the thermal stability of high temperature stars of the type considered. There may, however, be

other situations in high energy astrophysics in which thermonuclear pion production is a more significant process. (UK)

49176 HIGH-ENERGY DEUTERON SCATTERING. Rihan, T. H. (International Atomic Energy Agency, Trieste, Italy). Nuovo Cim., 63A: 468-74(Sept. 21, 1969).

The second iterative solution to the Faddeev equations is adapted for high-energy deuteron scattering. With the aid of some reasonable approximations, which seem intuitively justified at high energies and low momentum transfer, a modification to the Glauber approximation is obtained. (auth)

49177 EQUATION OF STATE FOR A DEGENERATE BARYON GAS INCLUDING STRONG FORCES. Libby, L. Marshall (Univ. of Colorado, Boulder. RAND Corp., Santa Monica, Calif.); Thomas, F. J. Phys. Lett., 30B: 88-90(Sept. 15, 1969).

The equation of state for a degenerate gas of the 45 known species of baryons is computed for 0°K, with inclusion of the interaction energy derived from high energy proton-proton elastic scattering. A region of partial collapse is indicated for density $\sim 10^{40}$ cm^{-3}. (auth)

Particle Invariance Principles and Symmetries

Refer also to abstract 48045.

General

Refer also to abstract 49213.

49178 APPLICATIONS OF INVARIANCE PRINCIPLES IN THE PHYSICS OF ELEMENTARY PARTICLES. Nguyen-Khac, U. (Ecole Polytechnique, Paris); Six, J. pp 177-228 of Analysis of Scattering and Decay. Nikolic, M. (ed.). New York, Gordon and Breach Science Publishers Inc., 1968.

The known invariances are defined as concisely as possible, and consequences for elementary particle interactions are drawn from them. Laws valid for all interactions, C, P, and T invariances, charge symmetry and charge independence, isotopic spin, isotopic parity, particular rules for weak interactions, and applications of selection rules in the case of strong and electromagnetic interactions are discussed. (32 references) (J.F.P.)

49179 EXPERIMENTS IN TIME REVERSAL. Overseth, Oliver E. Sci. Amer., 221: No. 4, 89-94; 100; 101(Oct. 1969).

The concept of time reversal and the role that it plays in physics is first discussed. Some methods and results of experimental tests of time reversal invariance are summarized. A typical experiment involving lambda decay into a proton and a pion is described in detail. (L.B.S.)

49180 SU(3) CROSSING MATRIX AND 6-pq AND 9-pq SYMBOLS. Chew, C. K. (Laval Univ., Quebec). Nuovo Cim., 63A: 377-92(Sept. 21, 1969).

A 6-pq and a 9-pq symbol are defined and given in simplified expressions. Symmetry properties, orthogonality relations and sum rules for the 6-pq and 9-pq symbols are given with phase factors and degeneracy labels specified. Two expressions for the SU_3 crossing matrix in terms of a 6-pq and a special 9-pq symbol are given; the latter is preferred for examining the symmetry properties of the SU_3 crossing matrix. Three useful equalities are derived, one of which was stated by de Swart without proof. (auth)

49181 FUNDAMENTAL PARTICLE PHYSICS. 1967 Tokyo Summer Lectures in Theoretical Physics. Takeda, Gyo; Hara, Yasuo (eds.). New York, W. A. Benjamin, Inc., 1968. 174p. $12.50.

Eight lectures are presented. Separate abstracts were prepared for each lecture. (J.F.P.)

For abstracts of individual sections see: 49117, 49124, 49186–49189, 49192, and 49222.

Applications (Electromagnetic and Weak)

Refer also to abstracts 49040 and 49319.

49182 (ITEF-650) ANGULAR T-NONINVARIANT CORRELATIONS IN NUCLEAR ELECTROMAGNETIC RADIATION. Krupchitskii, P. A. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki). 1968. 51p. (In Russian). Dep. CFSTI (U. S. Sales Only).

Different effects in the processes of the emission and absorption of photons by nuclei which appear by violation of time-invariance (T) of strong and electromagnetic interactions of hadrons are considered in this review. These effects are the following: angular correlations of two cascade photons in the polarized nuclei decay, angular correlations in the photon resonant scattering by polarized nuclei by means of the Moessbauer effect. Simple analytic expressions for the angular correlation coefficients in the case of electric and magnetic dipole and quadrupole nuclear transitions with arbitrary spin values are given. Effects of virtual photon exchange which lead to the appearance of angular T-noninvariant correlations even with the existence of time invariance of strong and electromagnetic interactions of hadrons are discussed. The experiments on this problem are given and discussed. (auth)

49183 POSSIBLE C,T VIOLATION IN ELECTROMAGNETIC INTERACTIONS. Mittner, P. (CERN, Geneva). pp 745-75 of Methods in Subnuclear Physics. Vol. III. Nikolic, M. (ed.). New York, Gordon and Breach Science Publishers Inc., 1969.

The invariances CP, CPT, C, P, and T are studied. The meson (K^0_2) decay and invariance principles, possible C, T noninvariance in electromagnetic interactions of hadrons, and meson (η) decay experiments are covered. (47 references) (J.F.P.)

49184 EXPERIMENTAL TESTS OF TIME REVERSAL INVARIANCE. Commins, E. D. (Univ. of California, Berkeley). pp 487-97 of Methods in Subnuclear Physics. Vol. III. Nikolic, M. (ed.). New York, Gordon and Breach Science Publishers Inc., 1969.

Some recent experiments in which a search was made for T violation are discussed. While no positive evidence for T violation was found, the experimental precision is sufficient to allow some conclusions. The strong, electromagnetic, and weak interactions are discussed. (32 references) (J.F.P.)

49185 PHYSICAL LAWS IN ACCELERATED REFERENCE SYSTEMS. Heintzmann, H.; Mittelstaedt, P. (Univ., Cologne). Ergeb. Exakten Naturwiss., 47: 185-225(1968). (In German).

An accurate definition is given of the concepts coordinate system and reference system. The general proof of the covariance principle is presented. The concrete applications of this principle to mechanics and electrodynamics are investigated. The special reference systems—the uniform accelerated reference system (hyperbolic motion), the uniform rotating reference system, and the expanding space-time of negative curvature—are also studied. (J.S.R.)

49186 CHIRAL DYNAMICS. Yamaguchi, Yoshio (Tokyo Univ.). pp 24-42 of Fundamental Particle Physics. Takeda, Gyo; Hara, Yasuo (eds.). New York, W. A. Benjamin, Inc., 1968.

A general way to formulate chiral SU(2) × SU(2) is given which is suitable to generalized to the U(3) × U(3) case. The U(3) × U(3) chiral dynamics of quarks, and pseudoscalar and gauge fields are discussed. The incorporation of baryons into this scheme is briefly mentioned. (J.F.P.)

49187 ALGEBRA OF THE OBSERVED CURRENT OPERATORS. Lee, T. D. (Columbia Univ., New York). pp 74-101 of Fundamental Particle Physics. Takeda, Gyo; Hara, Yasuo (eds.). New York, W. A. Benjamin, Inc., 1968.

The possibility that the observed current operators for electromagnetic and weak interactions may satisfy a set of simple and exact algebraic relations is studied. The field–current identity, application to $(J^i_\beta)_{\lambda=1}$, the isoscalar electromagnetic current, and algebra of the observed currents are discussed. (J.F.P.)

49188 C, P, T SYMMETRIES. Lee, T. D. (Columbia Univ., New York). pp 102-15 of Fundamental Particles Physics. Takeda, Gyo; Hara, Yasuo (eds.). New York, W. A. Benjamin, Inc., 1968.

The discussion of C, P, and T invariance principles covers violations, time reversal invariance, implication of nonconservation and group extension. The possible existence of a C and T violating electromagnetic interaction is also discussed including some necessary properties of K_μ, classification, some further properties of Q_K, experimental consequences of K_μ and application of the field current identity. (J.F.P.)

49189 TCP INVARIANCE, TIME-REVERSAL INVARIANCE, AND K-MESON DECAY. Gourdin, M. (Laboratoire de Physique Theorique et Hautes Energies, Orsay, France). pp 132-60 of Fundamental Particle Physics. Takeda, Gyo; Hara, Yasuo (eds.). New York, W. A. Benjamin, Inc., 1968.

A discussion of the existence of possible discrete symmetries is presented in connection with meson (K) decay. Quantum mechanics, the CPT invariance, time-reversal invariance, and the 2π and 3π models are considered. (J.F.P.)

Applications (Strong)

Refer also to abstracts 49044, 49087, 49124, 49126, 49184, and 49319.

49190 BARYON OCTET MASSES IN BROKEN SU(3) ⊗ SU(3). Lam, Yuk-ming P.; Lee, Yee Yen (Univ. of Chicago). Contract AT(11-1)-264. Phys. Rev. Lett., 23: 734-6(Sept. 29, 1969).

The contribution to the baryon octet masses of the symmetry breaking term $u_8 + cu_8$ is calculated by means of a phenomenological Lagrangian. The result gives a theoretical justification of the conclusion of von Hippel and Kim. (auth)

49191 SU(4) POLYNOMIAL BASES. Jakimow, G.; Sharp, R. T. (McGill Univ., Montreal). Can. J. Phys., 47: 2137-42 (Oct. 15, 1969).

Bases are derived for the irreducible representations of SU(4) as polynomials in the states of the three fundamental representations (100), (010), and (001) by forming first the bases (λ00), (0μ0), and (00ν) and then constructing ($\lambda\mu\nu$) as their stretched product. (auth)

49192 A MODEL OF CP VIOLATION. Nishijima, K. (Tokyo Univ.). pp 116-31 of Fundamental Particle Physics. Takeda, Gyo; Hara, Yasuo (eds.). New York, W. A. Benjamin, Inc., 1968.

A model of nonleptonic decays is proposed based on an assumption that both CP-conserving and -violating decays should be described in terms of the same primary interaction. The primary interaction, the selection rule $|\Delta S| < 2$ and new constraints, S-wave hyperon decays, the CP-violating decay $K_2^0 \to 2\pi$, and the neutron electric dipole moment are discussed. (J.F.P.)

Field Theories

Quantum Field Theory

Refer also to abstracts 49032, 49089, 49122, and 49159.

49193 BOOTSTRAP OF POMERANCHUK CUT. Hwa, R. C. (State Univ. of New York, Stony Brook). Contract AT(30-1)-3668. Nuovo Cim., Lett., 2: 369-75(Sept. 11, 1969).

The two-Reggeon unitarity equation is used to perform a bootstrap calculation of the asymptotic behavior. It is required that the leading vacuum singularity bootstraps itself, in accordance with the observation that diffractive excitation processes persist at high energies. The nature of the singularity is determined by the asymptotic s dependence. (L.B.S.)

49194 WHAT IS THE POINT OF SO-CALLED "AXIOMATIC FIELD THEORY"? Wightman, Arthur S. (Princeton Univ., N. J.). Phys. Today, 22: No. 9, 53-8(Sept. 1969).

A historical account is given of the development of quantum field theory. Some of the problems and prospects for future development of the theory are discussed. (L.B.S.)

49195 ON THE REALIZATION OF LOCALITY ON A SPACE OF ONE-PARTICLE STATES. Conti, A.; Minguzzi, A. (Univ., Lecce, Italy. Istituto Nazionale di Fisica Nucleare, Bari, Italy). Nuovo Cim., Lett., 2: 342-4(Sept. 11, 1969).

It is investigated whether locality can be realized in a space of single-particle states. The most general distribution is represented by the Jost–Lehmann–Dyson formula. (L.B.S.)

49196 ELEMENTARY AND COMPOSITE PARTICLES IN THE FRAMEWORK OF THE MODELS OF QUANTUM FIELD THEORY. Gherman, O.; Magyari, E.; Tataru, L.; Uliu, F. (Univ., Craiova, Rumania). Stud. Cercet. Fiz., 21: 299-335 (1969). (In Rumanian).

The discussion of elementary and composite particles in models of quantum field theory covers the Lee model including the Low equation, general and N/D solutions of the Low equation, compositeness and bootstrap. The Zachariasen model, solution of the integral equation for baryon–antibaryon scattering by the Herglotz function method, calculation of the renormalization factors Z_3Z_1 and δM_Λ^2, and the limit $Z_3 = 0$, are also discussed. (J.F.P.)

49197 ELEMENTARY AND COMPOSITE PARTICLES IN THE FRAMEWORK OF MODELS OF QUANTUM FIELD THEORY. II. CHEW–LOW MODEL. Gherman, O.; Magyari, E.; Tataru, L.; Uliu, F. (Univ., Craiova, Romania). Stud. Cercet. Fiz., 21: 429-65(1969). (In Rumanian).

The Chew–Low model is discussed. The Low equation, the solution of the Low equation, and bootstrap solution of the Chew–Low model are considered. (J.F.P.)

49198 EXPERIMENTAL TESTS OF QUANTUM ELECTRODYNAMICS. Lohrmann, E. (Deutsches Elektronen-Synchrotron, Hamburg). pp 541-66 of Methods in Subnuclear Physics. Vol. III. Nikolic, M. (ed.). New York, Gordon and Breach Science Publishers Inc., 1969.

Experiments for testing quantum electrodynamics are reviewed. These include low-energy experiments covering the Lamb shift, the anomalous magnetic moment of the electron and muon, and the fine-structure constant and hyperfine splitting. Also high-energy experiments are reviewed including electron–proton and electron–muon scattering, wide-angle electron- and muon-pair production, electron–electron scattering, experiments to be performed, and other tests connected with electromagnetic interactions. (51 references) (J.F.P.)

49199 ANOMALOUS MAGNETIC MOMENT OF THE ELECTRON AND MUON. Picasso, E. (CERN, Geneva). pp 499-539 of Methods in Subnuclear Physics. Vol. III. Nikolic, M. (ed.). New York, Gordon and Breach Science Publishers Inc., 1969.

The discussion includes the status of theoretical considerations, the (g−2) measurements of the electron, the (g−2) measurements of the meson (μ^+) performed at the CERN synchrocyclotron, the CERN muon storage ring, and the new (g−2) measurement on the meson (μ^-). (56 references) (J.F.P.)

49200 FIELD THEORY DESCRIBING INTERACTING TWO-PARTICLE SUBSYSTEMS. II. DESCRIPTION OF ELASTIC SCATTERING. Karwowski, W.; Lukierski, J.; Sznajder, N. (Univ. of Wroclaw). Nuovo Cim., 63A: 509-28(Sept. 21, 1969).

The field operators $\varphi(x, s)$ having c-number commutators, are investigated. If the spectral function $\rho(s, s'; \varkappa^2) = K(s; \varkappa^2)\, K(s'; \varkappa^2)$ is chosen the operators $\varphi(x, s)$ characterize decoupled two-particle S-wave subsystems, and particularly can be used for the description of space-time development of the elastic S-wave resonant scattering. The relation between the definition of elastic resonance in our field-theoretical model, and the conventional definition, using $2 \to 2$ scattering amplitude, is explained. The explicit formulas for the asymptotic fields φ_{in}, φ_{out} are given, and the S-wave scattering phase shift is expressed in terms of the spectral function $\rho(s, s'; \varkappa^2)$ defining the commutation relations of the φ-field. In order to describe the most general class of free fields $\varphi(x, s)$ having c-number commutators, it is necessary to introduce the notion of generalized Licht fields. Also the infinite-component field operator, describing full $2 \to 2$ elastic-scattering process, is introduced. In Appendix A, for the sake of completeness, the proof of asymptotic condition, which was only assumed to be valid in I, is presented. (auth)

49201 SOME NONLINEAR LAGRANGIAN MODELS COMBINING CHIRAL SYMMETRY AND SPIN INDEPENDENCE. Chang, P.; Guersey, F. (Middle East Technical Univ., Ankara). Nuovo Cim., 63A: 617-38(Sept. 21, 1969).

Some Lagrangian models embodying both chiral symmetry and partial spin independence are proposed. In the zero-mass limit for mesons, the Lagrangians are invariant under covariant groups like $SL_{2,C}$ or $SL_{2,C} \otimes SL_{2,C} \otimes U_1 \otimes U_1$ in the case of no internal symmetry. The groups can be generalized to $SL_{6,C}$ or $SL_{6,C} \otimes SL_{6,C}$. The symmetry is of the unconventional kind like chiral symmetry in so far as it does not respect the invariance of the vacuum or the stability of one-particle states. Pseudovector mesons transform nonlinearly with respect to spin transformations just as pseudoscalar mesons obey nonlinear-transformation laws in the case of chiral groups. Mesons that transform linearly and baryons can be classified by a compact subgroup of the covariant group. A definite way of breaking the symmetry leads to sum rules of the Weinberg type. (auth)

49202 EXACT RESULT IN TWO-DIMENSIONAL QUANTUM ELECTRODYNAMICS WITH NONZERO FERMION MASS. Haberler, P. L. F. (CERN, Geneva). Nuovo Cim., 63A: 675-96 (Oct. 1, 1969).

In two-dimensional spinor electrodynamics with nonvanishing fermion mass it is proved—using results of Brandt—that $[j_0^{in}(x,t),\ j_1^{in}(y,t)] = +\,(i/\pi)e_0^2\partial_1\delta(x-y)$, where $j_\mu^{in}(k)$ is the exact unrenormalized electromagnetic current. Implications for the exact solution of the vacuum polarization are discussed. (auth)

49203 SCHWINGER TERMS AND COVARIANT BJORKEN EXPANSIONS FOR TWO- AND THREE-POINT FUNCTIONS. Ciccariello, S.; Sartori, G.; Tonin, M. (Univ., Padua. Istituto Nazionale di Fisica Nucleare, Padua). Nuovo Cim., 63A: 846-62(Oct. 1, 1969).

It is shown how the limitations on the Schwinger terms due to covariance requirements allow a covariant asymptotic expansion for the Fourier transforms of T*-products to be obtained, when the relevant momenta go to ∞. The resulting recipe is given explicitly for two- and three-point functions and can be generalized to n-point functions. (auth)

Gravitation and General Relativity

Refer also to abstract 49124.

49204 SUPPRESSION OF INFINITES IN EINSTEIN'S GRAVITATIONAL THEORY. Delbourgo, R.; Salam, A.; Strathdee, J. (International Atomic Energy Agency, Miramare, Italy). Nuovo Cim., Lett., 2: 354-9(Sept. 11, 1969).

A computational procedure was recently developed for non-polynomial Lagrangians, which shows that the gravitational Lagrangian is renormalizable, and exhibits explicitly the conjectured suppression of some of the ultraviolet infinities of other fields. It is indicated how a further refinement of the methods may result in a suppression of all infinities in a field theory of matter. (L.B.S.)

49205 GRAVITATIONAL ACTION PRINCIPLE. Ray, J. R. (Clemson Univ., S. C.). Nuovo Cim., Lett., 2: 333-5(Sept. 11, 1969).

It is shown that in deriving the gravitational field equations from the principle of stationary action the contravariant metric tensor g^{ik} may be chosen as the gravitational field variables, even though the Lagrangian density for the gravitational field must also contain the covariant metric tensor g_{ik}. (L.B.S.)

49206 SIGNIFICANT CONFORMAL METRICS. Kumar, M. M. (M. S. Coll., Motihari, India). Nuovo Cim., 63A: 559-73(Sept. 21, 1969).

Some simple adiabatic spherically symmetric gravitational-collapse models with uniform density and pressure gradient are obtained by conformal transformation of well-known metrics. It is found that some general theorems given by Misner and Sharp for adiabatic spherically symmetric gravitational collapse models are applicable to the models developed in this paper. (auth)

49207 COMPARISON OF TWO METHODS OF DIFFERENTIATION OF REFERENCE FRAMES AND COORDINATE SYSTEMS IN THE EINSTEIN GRAVITATIONAL THEORY. Ivanitskaya, O. S. (Inst. of Physics, Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Mat. Navuk, No. 3, 69-72(1969). (In Russian).

It is shown that the transformation of reference frames in the Einstein gravitational theory according to Zel'man–Katten latently involves local Lorentz transformation of hyperbolic rotation. Certain chronometric transformation properties of the invariants were examined relative to this transformation. (tr-auth)

49208 SCALAR MODEL OF GENERAL REALTIVITY THEORY. Levashev, A. E.; Tunyak, V. N. (Belorussian State Univ., Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Mat. Navuk, No. 3, 73-6(1969). (In Russian).

The scalar model of general relativity theory was examined. General covariant generalized Newton gravitational theory, the energy–momentum tensor of the gravitational field, coincident isotropic geodetic simulation, and space simulation were discussed. (tr-auth)

Scattering Theory

Refer also to abstracts 49061, 49063, 49139, and 49140.

49209 APPROXIMATE SOLUTION OF THE THREE-BODY PROBLEM WITH A LOCAL POTENTIAL. Akhmatkhodzhaev, B.; Belyaev, V. B.; Wrzecionko, E. (Joint Inst. for Nuclear Research, Dubna, USSR). JETP Lett. (USSR) (Engl. Transl.), 9: 433-4(June 20, 1969).

Translated from Zh. Eksp. Teor. Fiz., Pisma Redaktsiyu, 9: 692-4(June 20, 1969).

The Faddeev equations for a system of three spinless particles interacting by a Yukawa potential were solved using the T-matrix with n = 1, 2, 3, and 4. The dependence of the binding energy of the system on the coupling constant G was calculated. Three levels appear for n = 2, 3, and 4. (J.F.P.)

49210 ANALYTICITY AND PADE METHOD IN THE BOUND-STATE PROBLEM. Turchetti, G.; Villani, M. (Univ., Bari, Italy). Nuovo Cim., Lett., 2: 363-8(Sept. 11, 1969).

A prescription is given for treating the analyticity problem which occurs in the application of the Pade approximants to bound-state calculations. Explicit calculations of S-wave bound states for Yukawa, exponential, and square well potentials were performed to check the validity of the procedure. (L.B.S.)

49211 REMARKS ON A VENEZIANO-TYPE FORMULA WITH LOGARITHMIC TRAJECTORIES. Capra, F. (Univ. of California, Santa Cruz). Phys. Lett., 30B: 53-5(Sept. 1, 1969).

Two aspect of a Veneziano-type formula with logarithmic trajectories, proposed recently by Coon, are discussed: (1) the formula can not be used to construct an amplitude which is crossing symmetric and Regge behaved in all channels, (2) the odd daughter trajectories can not be eliminated by a restriction on the trajectory functions as in the Veneziano model. The second point is further illustrated by applying Coon's modification of the Veneziano formula to the Virasoro amplitude. (auth)

49212 THREE-BODY PROBLEM: FADDEEV EQUATIONS. Basdevant, J. L. (Physique Theorique Centre de Recherches Nucleaires, Strasbourg). pp 1-27 of Methods in Subnuclear Physics. Vol. III. Nikolic, M. (ed.). New York, Gordon and Breach Science Publishers Inc., 1969.

The nonrelativistic two-body problem is considered including the Lippmann–Schwinger equation, and diagrams. Three-particle systems are discussed covering kinematics, two-body subsystems in a three-body scattering problem, and Faddeev equations. Lastly the practical three-body problem is described covering Faddeev equations, production processes, three-body bound states and resonances, scattering on a bound state, and relativistic Faddeev equations. (J.F.P.)

49213 DISPERSION SUM RULES AND UNITARY SYMMETRY. Faustov, R. (Joint Inst. for Nuclear Research, Dubna, USSR). pp 457-86 of Methods in Subnuclear Physics. Vol. III. Nikolic, M. (ed.). New York, Gordon and Breach Science Publishers Inc., 1969.

The dispersion sum rules, the deriving of which only the local properties of the currents and the assumptions about the high-energy behavior of the scattering amplitudes were used, are analyzed in detail. Local currents, asymptotic properties of the invariant amplitudes, mass formulas in broken SU(3) symmetry, meson–baryon scattering, photoproduction of mesons on baryons, and the Cabibbo–Radicati relation are discussed. (40 references) (J.F.P.)

49214 ANALYSIS OF SCATTERING AND DECAY. Nikolic, M. (ed.). Documents on Modern Physics. New York, Gordon and Breach Science Publishers Inc., 1968. 339p. $12.50.

Selected articles from the first and second sessions of the Herceg–Novi International School of Elementary Particle Physics as well as articles from the CERN 1964 Easter School concerning analysis of scattering and decay are presented. Separate abstracts are prepared for each of the five papers included. (C.E.S.)

For abstracts of individual papers see: 49063, 49064, 49178, 49215, and 49216.

49215 TOPICS ON ELEMENTARY THEORY OF SCATTERING. Costa, Giovanni (Univ., Padua). pp 1-36 of Analysis of Scattering and Decay. Nikolic, M. (ed.). New York, Gordon and Breach Science Publishers Inc., 1968.

The topics covered for the study of scattering theory include scattering by a central potential, particles with spin, inelastic collisions, multichannel formalism, and Regge poles. (18 references) (J.F.P.)

49216 PHASE SHIFT ANALYSIS. Waloschek, P. (Istituto Nazionale di Fisica Nucleare, Bologna). pp 37-99 of Analysis of Scattering and Decay. Nikolic, M. (ed.). New York, Gordon and Breach Science Publishers Inc., 1968.

The scattering of two bodies or particles moving in space in general isolated from the rest of the universe is studied. A set of formulas is presented of practical interest especially for experimentalists. Scattering formulas without spin, experimental data, pion–pion scattering, and pion–proton scattering are covered. (10 references) (J.F.P.)

49217 AMBIGUITIES OF COMPLEX PHASE-SHIFT ANALYSIS. Gersten, A. (Weizmann Inst. of Science, Rehovoth, Israel). Nucl. Phys., B12: 537-48(1969).

It is well known that there exist ambiguities of phase-shift analysis for real potential scattering. For complex potential scattering (complex phase shifts) additional ambiguities arise. The ambiguities of complex phase-shift analysis made for a definite number of partial waves and given energy are considered. For a given set of complex phase shifts describing elastic scattering of spinless particles all other sets of complex phase shifts are given which correspond to the same total cross section and differential elastic cross section. For a given set of complex phase shifts describing the elastic scattering of spin one-half particles on spinless particles, all other sets of phase shifts which correspond to the same total cross section, differential elastic cross section and polarization are given. Not all ambiguous sets of phase shifts are physically acceptable. Checking with the unitary condition allows one to sift out the unacceptable sets. (auth)

49218 REGGE TRAJECTORIES IN THE WICK-CUTKOSKY MODEL. Arafune, J. (Gakushuin Univ., Tokyo); Ezawa, H.;

Nakamura, K.; Murai, N. Nuovo Cim., Lett., 2: 394-8(Sept. 21, 1969).

Previous results of a perturbation calculation to first order in the coupling constant, to indicate that the Regge trajectories $n(\eta^2)$ in the Wick–Cutkosky model should undergo pairwise collision to become complex, were examined without using the perturbation expansion in the coupling constant. Analytical calculations for the regions of $|\eta^2| \ll 1$ and $|\eta^2| \gg 1$, and numerical calculations were carried out using the computer for the intermediate values of η^2. The results show that the previous approximation is not good enough to deal with collisions of trajectories with such large values of the coupling constant as 4. The obtained features of the trajectories are shown. The global pattern could be similar irrespective of the coupling constant, and the positions relative to the n-axis would change. (J.F.P.)

49219 BUILDING OF DUAL DIAGRAMS FROM UNITARITY. Amati, D.; Bouchiat, C.; Gervais, J. L. (Laboratoire de Physique Theorique et Hautes Energies, Orsay, France). Nuovo Cim., Lett., 2: 399-406(Sept. 21, 1969).

It is pointed out that unitarity can be used with the Veneziano amplitude for the construction of a hadron theory in the same way in which it can be used to construct quantum electrodynamics from the photon and electron poles considered as Born terms. In this way crossing and duality are exactly preserved at every step keeping in the theory the accomplishment of the Veneziano model. The real amplitude of the multiparticle Veneziano model is considered as the tree diagram of the theory. The one-loop diagram is built in such a way that if the loop is cut one finds the corresponding tree diagram. (J.F.P.)

49220 GENERAL VERTEX FUNCTION IN DUAL RESONANCE MODELS. Sciuto, S. (Univ., Turin). Nuovo Cim., Lett., 2: 411-18(Sept. 21, 1969).

A closed form for the general vertex function for three excited particles is found, since a knowledge of this vertex is required in order to complete the problem of algebraization of dual resonance models. It is found that the general vertex function has a rather simple form, but this form is asymmetrical in the exchange of the external lines. (J.F.P.)

49221 NOTE ON INVERSE PROBLEMS IN POTENTIAL SCATTERING. Viano, G. A. (Univ., Genoa, Istituto Nazionale di Fisica Nucleare, Genoa). Nuovo Cim., 63A: 581-97(Sept. 21, 1969).

Some types of "inverse problems" in the theory of potential scattering are discussed from the point of view of the so-called "improperly posed problems." (auth)

49222 DAUGHTER TRAJECTORIES AND BETHE–SALPETER GHOSTS. Nakanishi, N. (Kyoto Univ.). pp 161-7 of Fundamental Particle Physics. Takeda, Gyo; Hara, Yasuo (eds.). New York, W. A. Benjamin, Inc., 1968.

A review of the theory of daughter Regge trajectories is given considering the u-channel high-energy asymptotic behavior of the backward elastic scattering of two unequal-mass particles. The existence of daughter trajectories and its intimate relation to the Lorentz invariance of the Bethe–Salpeter equation are shown. Complex angular momentum in the Bethe–Salpeter equation is discussed. The problem of whether the Regge trajectory (s) and the reduced residue function β (s) become single analytic functions of s is investigated by means of the scattering Green function by continuing the angular momentum of a bound-state pole into complex values. The appearance of Bethe–Salpeter ghosts is found. The Wick–Cutkosky model for equal- and unequal-mass scattering is discussed. It is found that in the equal-mass case no ghost Regge poles appear on the mass shell, but in the unequal-mass case ghost Regge poles survive on the mass shell. It is noted that the existence of the Bethe–Salpeter ghosts are essential in the Freedman–Wang cancellation. It is indicated that in order to investigate the behavior of the daughter trajectories near the elastic threshold the nonrelativistic Regge trajectories must be analyzed. (J.F.P.)

49223 INVARIANT FUNCTIONS AND DISCRETE SYMMETRIES. II. Kleinert, H.; Muetter, K. H. (Freie Univ., Berlin). Nuovo Cim., 63A: 657-74(Oct. 1, 1969).

A Lorentz-covariant spinor basis for the scattering of spin configurations $(s,\frac{1}{2}) \rightarrow (s,\frac{1}{2})$ is constructed for massive particles producing scalar amplitudes which are free of kinematic singularities, real analytic, and eigenstates of P, T and $s \rightarrow u$ crossing. (auth)

49224 COLLISION-PROCESS LIFETIMES AND CAUSALITY. Olkhovskii, V. S. (Institut Teoreticheskoi Fiziki, Kiev. Kievskii Gosudarstvennii Univ., Kiev); Recami, E. Nuovo Cim., 63A: 814-26(Oct. 1, 1969).

Previous results on particle collision lifetimes are generalized, by defining and calculating reaction and partial-process lifetimes, to the case of two-wave-packet collisions with an arbitrary number of final packets. The principle of causality and the new one of "anticausality" are expressed in terms of interaction time shifts. Some notes about tachyons are added. (auth)

49225 CROSSING THE TRIANGLE-GRAPH DISCONTINUITY FORMULA. Hindle, C. M. (Cambridge Univ., Eng.). Nuovo Cim., 63A: 827-45(Oct. 1, 1969).

The possibility of continuing the discontinuity formulas of analytic S-matrix theory from one component of the physical region to another is illustrated by an explicit treatment in terms of Lorentz scalars, of the triangle singularity in the 3-3 amplitude. The difficulty associated with generative mechanisms is pointed out. (auth)

Particle Accelerators

Refer also to abstracts 47712, 47802, 47811, 47815, 47871, 47881, 47907, and 49393.

49226 (AD–689732) REPORT OF CYCLOTRON OPERATION, JULY 1–DECEMBER 31, 1968. (Naval Research Lab., Washington, D. C.). Mar. 1969. 65p. (NRL–MR–1992). CFSTI.

The operation and use of the NRL Sector-Focusing Cyclotron is described for the period 1 July–31 December 1968. An active research program consisting of five experimental studies was initiated and vigorously pursued during this period. Several additional experiments were designed and equipment procurement was initiated. An average operational efficiency of 64% was reached for the entire cyclotron facility. The extended operation for research purposes has furnished valuable data on stability and reliability of the magnet power supplies and R.F. system. The beam path into Room 1 became operational in December and is used primarily for radioisotope production. Plans are being developed for future installation of additional beam paths into Rooms 2 and 3. These beam paths are necessary for starting new research programs. (auth) (USGRDR)

49227 (AD–689734) THE DEMINERALIZED WATER SYSTEM FOR THE NRL CYCLOTRON. Final Report on Phase 1. Bondelid, R. O. (Naval Research Lab., Washington, D. C.). Apr. 4, 1968. 17p. (NRL–6670). CFSTI.

Since it is necessary to remove up to 4 MW of heat from various magnets, power supplies, and other heat-generating units of the NRL Cyclotron, an air-handling system was considered impractical to handle this heat load. Therefore, the demineralized water system for the NRL Sector-Focusing Cyclotron Facility was designed after carefully considering the power requirements of the facility and the present state of water chemistry. Thus, the heat generated by the cyclotron is removed by water in a closed-loop system in which the conductivity, oxygen content, and insoluble particulate matter are all kept at a low value, as required for efficient operation of the system, and are continuously monitored. A means for temperature regulation of the water by the use of four temperature control units is provided. In an effort to prevent leaks from forming at weakened points in the system, it was decided to run the water system on a continuous basis. Continuous operation can be dangerous, because it can cause a large leak to occur, but this possibility has been decreased by the use of an optical level sensor which monitors the level of the water. (auth)(USGRDR)

49228 (AD–689737) FORTRAN PROGRAMS FOR FIRST ORDER CALCULATION OF PROPERTIES OF BEAM TRANSPORT SYSTEMS. Final Report. Shapiro, Philip (Naval Research Lab., Washington, D. C.). June 20, 1968. 60p. (NRL–6710). CFSTI.

A set of FORTRAN functions and subroutines has been written to facilitate calculations, using matrix techniques, of the first order properties of ion-optical systems for particle accelerators. These functions and subroutines generate matrices for various magnetic elements used in ion-optical systems and also program various matrix manipulations. A subroutine to calculate the strength of magnetic quadrupoles required to achieve prescribed focal conditions is available. Functions used to calculate the maximum excursion of a particle trajectory from the optic axis in a magnetic element, to calculate the waist of a particle beam if the emittance satisfies certain conditions, and to calculate the location of the focal plane for an arbitrary ion-optical arrangement have been written. Programs can be written, using these functions and subroutines, to calculate the properties of particular ion-optical systems. Illustrative coding shows how such programs are written. (auth)(USGRDR)

49229 (ANU–P–465) HYSTERESIS FREE RANGING OF VAN DE GRAAFF BEAM ENERGY. Lefevre, Harlan W. (Australian

National Univ., Canberra. Research School of Physical Sciences). [1969]. 6p. Dep. CFSTI (U. S. Sales Only).

An air core trimmer coil is described which can add or subtract an incremental deflection to the analyzed beam from a Van de Graaff accelerator. If the machine is stable this inexpensive technique may offer better resolution than is usually obtained from a nuclear magnetic resonance spectrometer of average performance. (UK)

49230 (BNL-13987) PLACEMENT OF AN ELECTROSTATIC DEFLECTOR FOR THE SLOW EXTERNAL BEAM IN THE AGS. Glenn, J. W. (Brookhaven National Lab., Upton, N. Y.). Aug. 27, 1969. 13p. Dep. CFSTI.

The characteristic of non-linear growth rate associated with subintegral extraction allows an enhancement of the splitting caused by a deflector used to separate part of the beam into an extraction channel. The third sub-integral resonance is discussed and numerical results using the AGS Beam Program are presented. These results indicate the new electrostatic thin septum deflector for the slow beam should be located in the H20 straight section. Possible usage of the septum for the I10 fast beam is discussed. (auth)

49231 (CNEA-238) CORRECTION AND REGULATION OF THE MAGNETIC FIELD OF THE CYCLOTRON. Mayo, S.; Sametband, M. J.; Sinderman, J. E.; Lorenzetti, J. R. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1969. 26p. (In Spanish). Dep. CFSTI (U. S. Sales Only).

The magnetic field in the Buenos Aires Synchrocyclotron was studied with a nuclear resonance fluxmeter, a Hall effect plate, and the floating wire technique. Azimuthal inhomogeneities were detected at several radii producing lack of coincidence between the geometric and magnetic median planes up to 1.5 cm and displacement of orbit centres from geometric centre up to 2.5 cm. Magnetic field corrections were performed by use of local shimming plates attached to the magnet pole tips. Shim designs for field reducing or field reinforcing corrections were made by use of nomograms which are presented. Field harmonic analyses show that after corrections were done the first harmonic component was reduced by a factor 20 at radii from 65 to 75 cm. The beam radial oscillation at 75 cm radius was consequently reduced by a factor 2. Complete cyclotron data are presented. Field regulation better than 0.01 per cent was obtained by time constant compensations in the original system of the power supply circuit which limited the open loop gain. (auth)

49232 (ISS-69/13) MEASUREMENT OF THE FRASCATI SYNCHROTRON RADIATION IN THE FAR ULTRAVIOLET REGION. Balzarotti, A.; Grandolfo, M.; Piacentini, M. (Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica). Mar. 6, 1969. 19p. Dep. CFSTI (U. S. Sales Only).

The characteristics of the synchrotron radiation emitted by the Frascati electron synchrotron in the far uv region are analyzed theoretically and experimentally. The experimental results on the spectral distribution of the radiation and on the transmission of thin aluminum films are presented and discussed. (auth)

49233 (KFK-891) SPIN PRECESSION MAGNET FOR HIGH ENERGY NEUTRONS AND CHARGED PARTICLES. Brueckmann, H.; Haase, E. L.; Kluge, W.; Schaenzler, L. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Experimentelle Kernphysik). Nov. 1968. 14p. (In German). Dep. CFSTI (U. S. Sales Only).

The method of spin rotation by means of a spin precession magnet has the advantage of eliminating instrumental asymmetries in polarization experiments. For such experiments at the Karlsruhe isochronous cyclotron a spin precession magnet was constructed, which is able to turn the spin of neutrons through 90° in either direction for energies of up to 70 MeV. The magnet is a solenoid with a length of 2.48 m and with a maximum rating of $(8.09 \pm 0.09) \cdot 10^5$ A turns. The solenoid is now in use for neutron polarization measurements, but it was found in experiments, that this magnet is also suitable for spin precession of charged particles. (auth)

49234 (NP-18023) ANNUAL REPORT, 1967. (TRI - Univ. Meson Facility, Vancouver (British Columbia)). Dec. 1967. 19p. Dep. CFSTI (U. S. Sales Only).

Activities over the year have been concentrated primarily on the design of the 500 MeV negative ion cyclotron. The major effort has gone into magnet design, based on model measurements. R.F. system design, using a resonator model, was started and a center region study is in progress, based on electrolytic tank measurements. Beam transport design has been studied with an analog computer, and vacuum system design has been studied. These design efforts have been supported by a survey of industrial resources for the various types of equipment. Engineering services, as available from private firms, have been evaluated. Design of building and site layout has progressed to the stage where an engineering firm can start working out a conceptual design. Pending completion of funding arrangements for the TRIUMF project the design work during 1967 has been supported by an interim grant from the Atomic Energy Control Board, at the rate of $100,000 per annum. (auth)

49235 (NP-18024) ANNUAL REPORT, 1968. Burgerjon, J. J. (ed.) (TRI - Univ. Meson Facility, Vancouver (British Columbia)). Dec. 1968. 44p. Dep. CFSTI (U. S. Sales Only).

A sharp rise in activities following the announcement on April 16, that funds had been approved is described. The terms of reference of the TRIUMF Board of Management were ratified by the Boards of Governors of the four participating universities, and the Board proceeded to appoint an Operating Committee for the project. Group leaders responsible for the different areas of research and development were appointed. Progress in the cyclotron and beam transport design has been increasing during the latter part of the year as specialist staff have joined. A Building Committee has been set up and a conceptual building and site layout completed. Specifications for the first stage Office/Laboratory building are ready for call of tenders. A Safety Committee has been appointed and has prepared a proposal concerning the safety requirements of the facility. Engineering firms have been awarded contracts for detailed design of the buildings, cyclotron and ancillary equipment. A project management office has been set up and has completed a first critical path schedule. Five Users Groups have been organized among the interested scientists in the North West. These groups have been examining the experimental use of the facility and the conceptual building layout. Special mention is made of the completion of the first TRIUMF physics experiment. With extraordinary help from the Rutherford Laboratory, using their Proton Linear Accelerator precise measurements were made of the lifetime of the H^- ion under conditions which pertain to the outer orbit radius for TRIUMF. These measurements were completed most expeditiously and in time to make the necessary adjustments to the cyclotron parameters without delay to the project. (auth)

49236 (NYO-2740-6, pp 209-33) RADIOLOGICAL RESEARCH ACCELERATOR FACILITY. Goodman, L. J.; Turner, C.; Rossi, H. H. (Columbia Univ., New York. Radiological Research Lab.).

The Radiological Research Accelerator Facility (RARAF) which is a joint venture between the Medical Research Center of BNL and the Radiological Research Laboratories at Columbia University is described. It will utilize charged particle beams, generated by a 5 mv Van de Graaff accelerator, principally to produce monoenergetic neutrons for research in radiobiology and radiological physics. The design and operating characteristics of the accelerator are examined. A brief description is also included of the radiation safety system, the laboratories and machine shop, and the auxiliary equipment. The future plans of the facility are discussed. (B.G.D.)

49237 (PPAD-662-E) THE PRINCETON-PENNSYLVANIA RAPID CYCLING, 3 GeV PROTON SYNCHROTRON: RECENT IMPROVEMENTS AND FUTURE PLANS. Kirchgessner, J. L. (Princeton-Pennsylvania Accelerator, Princeton, N. J.). Aug. 12, 1969. Contract AT(30-1)-3217. 14p. (CONF-690811-9). Dep. CFSTI.

From 7th International Conference on High Energy Accelerators, Moscow, USSR.

The present operation of the Princeton-Pennsylvania Accelerator is briefly outlined. Some of the design modifications underway for improving duty factor, deuteron and alpha acceleration, accelerator tube for the Van de Graaff, and beam current are discussed. The short and long range plans of the accelerator are included. (B.G.D.)

49238 (SLAC-Trans-99) LINEAR ION ACCELERATOR WITH SPATIALLY UNIFORM HARD FOCUSING. Kapchinskii, I. M.; Teplyakov, V. A. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki). Translated by T. Watt for Stanford Linear Accelerator Center, Calif., from report ITEP-673. 17p. Dep. CFSTI.

An ion linear accelerator in which the focusing and acceleration are achieved with a high-frequency electric field produced by a long four-conductor line is proposed. The accelerator contains no drift tubes. The advantages of this accelerator are its relative simplicity of design, small transverse dimensions, and possibility of substantially reducing the injection energy while maintaining the accelerated beam at a high intensity. (auth)

49239 (TRI-67-1) INITIAL MODEL MAGNET STUDY FOR A SIX-SECTOR 500 MeV H^- CYCLOTRON. Auld, E. G.; Burgerjon, J. J.; Craddock, M. K. (TRI - Univ. Meson Facility, Van-

couver (British Columbia)). Dec. 1967. 49p. Dep. CFSTI (U. S. Sales Only).

Initial model experiments aimed at a practical design for a 500 MeV H^- cyclotron magnet are described. The first problem is to obtain adequate vertical focusing all the way out to extraction radius, while keeping the size of the magnet to a minimum. This is because the magnetic field has to be kept low to limit the electric H^- dissociation which already dictates a very large magnet. Various coil configurations were tested and their efforts on the azimuthal variation, spiral angle and average field are described. A comparison of cost estimates for their full scale realization is presented. The report concludes with the design of new magnet parameters based on the best choice: a design with circular coils, larger, but basically the same as the one originally proposed. (auth)

49240 (TRI-68-1) CONCEPTUAL DESIGN STUDY FOR THE SUPPORT STRUCTURES, ELEVATING JACKS AND LEVELING JACKS FOR A 500 MeV H^- CYCLOTRON. (TRI - Univ. Meson Facility, Vancouver (British Columbia)). July 1968. 50p. Dep. CFSTI (U. S. Sales Only).

Studies of concept feasibility with alternative cost oriented design consideration for the supporting structures indicate that the basic concept of the cyclotron support structure, vacuum tank and magnet gap as established by TRIUMF is feasible. The recommended primary top structure would consist of straight I-section beams welded radially to a stiff center ring. Secondary structure would be bolted to the primary in order that the maximum crane lift be limited to approximately 100 tons. The top and bottom of the vacuum tank would be $\frac{7}{8}$ inches thick, supported by $1\frac{1}{2}$ inch diameter tie rods at a spacing not greater than 33 inches. Leveling of the magnet cores would be accomplished by a system consisting of hydraulic actuators for raising, used in conjunction with mechanically motor operated wedges for precise height setting. Alternatively, motor operated Acme screw jacks of 150 ton capacity operating through simple lever mechanisms should be considered further. To elevate the top structure and upper magnet cores, a system utilizing 150 ton Acme screw jacks synchronized to control vertical setting within 0.025 inches is recommended. Protective devices to prevent crushing of secondary coils between vacuum tank and magnet faces have been introduced. It is indicated that these stops will permit greater structural deflections with attendant decrease in beam depth and as such warrant further study. (auth)

49241 (TRI-68-3) CONCEPTUAL DESIGN STUDY AND COST ESTIMATE FOR THE MAIN COILS FOR A 500 MeV H^- CYCLOTRON. Fredriksson, O. K. (TRI - Univ. Meson Facility, Vancouver (British Columbia)). Nov. 1968. 56p. Dep. CFSTI (U. S. Sales Only).

A study has been conducted for the purpose of developing a design for the TRIUMF main magnet coils which was to result in a minimum capital investment when the costs of the coils and the power supply were added together. Two basic designs were considered, one being the more conventional design employing extruded square hollow conductor, the other making use of rectangular conductor bars. As a result of the study, it has been recommended that extruded bar aluminum conductor be employed in the fabrication of the coils and that 60° segments be used. The conductors should be insulated from each other and from ground by means of glass-epoxy laminates. It is also proposed that the insulation be reinforced by epoxy potting of the coil segments. The epoxy should be formulated to give maximum radiation resistance, and alumina grains should be used to further enhance this property. Bolted flexible copper connectors have been recommended for use between coil segments. The recommended coil design is shown on various figures and drawings along with graphs demonstrating power demands, capital investment costs and operating costs for different conductor materials and different number of coil turns. (auth)

49242 (TRI-68-4) SHIELDING AND ACTIVATION IN A 500 MeV H^- CYCLOTRON FACILITY. Thorson, I. M. (TRI - Univ. Meson Facility, Vancouver (British Columbia)). Dec. 1968. 65p. Dep. CFSTI (U. S. Sales Only).

The shielding required for the residual activity produced in the Tri-University Meson Facility (TRIUMF) are discussed. The facility is based on a 500 MeV H^- isochronous cyclotron capable of accelerating 100 μA of beam current. The 10 kW of beam power lost in the cyclotron by electromagnetic dissociation of the negative hydrogen ions will produce residual radiation fields in the cyclotron of the order of 1 Rem hr^{-1} a few hours after shutdown following a long operating period. The estimated shielding required around the periphery of the cyclotron to achieve radiation fields of 2.5 mRem hr^{-1} at full power is approximately 9 m of concrete. The primary beam dump designed for use as a neutron irradiation facility can produce a useful neutron flux of $\sim 5 \times 10^{12}$ cm^{-2} s^{-1} in the graphite moderator surrounding a 10 cm diameter lead or bismuth target. (auth)

49243 (TRI-68-7) PROGRAM TO CALCULATE THE PHASE SPACE ACCEPTANCE OF A BEAM HANDLING SYSTEM. THEORY AND PRELIMINARY RESULTS. Harrison, R. W.; Lobb, D. E. (TRI - Univ. Meson Facility, Vancouver (British Columbia)). Oct. 1968. 67p. Dep. CFSTI (U. S. Sales Only).

A computer program to determine the phase space acceptance of a beam transport system consisting of drift lengths, quadrupoles, and n = 0 bending magnets is described. It uses a technique which involves tracking trajectories obtained by a polar coordinate search pattern in initial phase space. The 3 × 3 first-order matrix formulation of Penner (1961) is used with the horizontal (x, x') and vertical (y, y') phase planes treated separately. This simplifies the calculations and interpretation but means that the treatment may be used only in the case of rectangular apertures. Examples are given to show the dependence of the acceptance upon system length, aperture, element spacing within the system, and particle energy. This program was written in Fortran IV for the IBM 360/44. (auth)

49244 (TRI-68-8) PRELIMINARY DESIGN OF TRANSPORT SYSTEMS FOR TRIUMF BEAM LINE I. Tautz, Maurice F. (TRI - Univ. Meson Facility, Vancouver (British Columbia)). Oct. 1968. 41p. Dep. CFSTI (U. S. Sales Only).

The design characteristics of a beam transport system for beam line I of the proposed TRIUMF isochronous cyclotron are described. It is shown that the beam is to undergo dispersionless extraction and then to be focused on up to three pion production targets located along the beam line before the neutron facility. The first target T_1 will be at a distance of about 15 to 20 meters from the accelerator exit. The transmitted beam is again focused on the second pion production target T_2 approximately 13 meters away and then on the third target T_3 situated about another 13 meters down the beam line. The systems have been designed to accommodate thin targets at T_1 and T_2 and either thin or thick targets at T_3. Finally, this beam, which will have a large emittance due to its interaction with the targets, must be transported to the neutron irradiation facility. (B.G.D.)

49245 (TRI-69-1) ELECTRIC DISSOCIATION OF H^- IONS BY MAGNETIC FIELSDS. Stinson, G. M.; Olsen, W. C.; McDonald, W. J.; Ford, P.; Axen, D.; Blackmore, E. W. (TRI - Univ. Meson Facility, Vancouver (British Columbia)). May 1969. 32p. Dep. CFSTI (U. S. Sales Only).

Electric $\vec{V} \times \vec{B}$ dissociation of H^- ions moving through a magnetic field has been measured for electric field strengths near 2 MV/cm. The H^- ions were obtained by charge exchange of protons in water vapor and were accelerated to 49.5 MeV by the proton linear accelerator at the Rutherford High Energy Laboratory. Stripped particles were detected using an acoustic spark-chamber. Experimental lifetimes are lower by approximately a factor of two from those predicted by Mullen and a factor of three from those predicted by Hiskes. Measurements also appear inconsistent with those of Cahill et al. (auth)

49246 (TRI-69-2) METHOD OF LOCATING THE MAGNETIC CENTRE OF A QUADRUPOLE MAGNET. Cobb, Roland W.; Pearce, R. M. (TRI - Univ. Meson Facility, Vancouver (British Columbia)). Feb. 1969. 8p. Dep. CFSTI (U. S. Sales Only).

A slack wire carrying an AC current with a square wave form is shown to take up a stable position on the axis of a quadrupole magnet. The stability condition is derived in terms of current, frequency, wire density, and field gradient. The accuracy with which the magnetic centre can be located is limited by kinking of the wire. (auth)

49247 (TRI-69-3) MAGNETIC FIELD MAPPING SYSTEM, AN OPERATION AND SERVICE MANUAL. Cobb, Roland W. (TRI - Univ. Meson Facility, Vancouver (British Columbia)). Feb. 1969. 51p. Dep. CFSTI (U. S. Sales Only).

An operation and maintenance manual for a magnetic field measuring system developed at the University of Victoria to study TRIUMF beam magnets is presented. The system consists of a three-dimensional coordinate table, a digital voltmeter, control and readout electronics, and a Teletype equipped with a paper type punch. This system provides a method of transporting a field-sensitive device (which are not described) throughout the volume of a magnetic field while obtaining a punched and typed record of positions and field readings. (B.G.D.)

49248 (UCRL-Trans-1400) ACCELERATING, IN A RESONATOR, A RELATIVISTIC BUNCH BEARING A LARGE CHARGE. Rubin, S. B.; Mamonov, V. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). Translated by I. M. R. Jones for Univ. of California, Lawrence Radiation Lab., Berkeley, from report JINR-P9-3346-2. 97p. Dep. CFSTI.

The question of loading a cylindrical resonator with the current of an electron bunch being accelerated in that resonator, and which is moving at a relativistic velocity and bears a large charge was examined. They discuss the problems associated with calculating the margin of energy in the resonator required to assure the necessary gathering of energy by the bunch. Expressions are adduced for the electrodynamic forces acting on the bunch, with allowance made for the self-action on the part of the field excited by it. (auth)

49249 HIGH-INTENSITY X-RAY FACILITY. Reyes L., J.; Limon M., M. A. (Univ. Nacional Autonoma de Mexico, Mexico City). Rev. Mex. Fis., 18: 195-207(1969).

The spatial dose distribution of the X-ray beam produced by the electron Van de Graaff accelerator at the Instituto de Fisica, UNAM, was determined using the chloral-hydrate aqueous-solution dosimeter. Mean mass absorption coefficients for several materials were also calculated in order to use the facility for several experiments. (auth)

49250 DEVICE FOR EXPANDING IRRADIATION FIELD IN THE BETATRON. Suzuki, Toru (to Toshiba Electric Co.). Japanese Patent 1969-14760. July 1, 1969. Filed Apr. 20, 1965.

By the method proposed, the cross section of an electron beam from the betatron can be expanded into a square, rectangle or circle, suitable for medical therapy, etc., furthermore, construction is simple and operation is stable. Immediately outside the exit of the charged-particle beam from the circular accelerating tube, an electromagnet in the form of a partly-cut ring, through which the beam passes, is installed. The cross-section of the beam is expanded in a direction perpendicular to the beam direction. A bi-stable multi-vibrator is used, which rotates in alternate directions by means of the pulses synchronized with the signals supplied to the orbit-expanding device. Then, a pair of electric switches are set, operable alternately with the outputs of the multi-vibrator. The pair of coils around the electromagnet are excited alternately, through the switches, and the condenser. (NSA of Japan)

49251 PARTICLE ACCELERATOR. Okada, Tsutomu (to Tokyo Shibaura Electric Co.). Japanese Patent 1969-12800. May 27, 1969. Filed Aug. 31, 1965.

The particle accelerator consists of the following: a modulator; an accelerating tube connected to the modulator, running in a vertical direction; a deflecting electrode at the end of the accelerating tube, to deflect the accelerated beam by 90°; a particle drift tube, connected to the same end of the accelerating tube at the angle of 90°, running in the forward horizontal direction; a deflecting electrode at the end of the drift tube, to deflect the particle beam by 90° in the vertical, inward direction; and a collimator, connected to the same end of the drift tube at the angle of 90°. Pairs of quadruple magnets, to focus the particle beam, are installed just before the first deflecting magnet, midway in the drift tube, and just after the second deflecting electrode. The particle accelerator as a whole is rotated in a usual manner. (NSA of Japan)

49252 DEVICE FOR DIRECTING PARTICLES. Maeda, Sukeo (to Mitsubishi Electric Mfg. Co.). Japanese Patent 1969-15839. July 8, 1969. Filed Nov. 29, 1965.

An accelerator which has the advantage of irradiating a target from all directions perpendicular to the object surface, even with a limited space for movement is described. It includes the following: an accelerating tube in the horizontal direction; an electromagnet to deflect by 90° the beam of particles from the accelerating tube; an electromagnet to deflect again by 90° the beam from the first electromagnet in the direction parallel to the accelerating tube axis; an electromagnet to deflect by 90° the beam from the second magnet in the direction perpendicular to the axis; beam ducts before the first magnet, between the magnets, and after the third magnet; and a target in front of the particle-beam exit. The whole of the deflecting mechanism, roughly in the form of flattened U (in the explanation given, this is inverted), is rotated along the axis of the accelerating tube. (NSA of Japan)

49253 ELECTRON-BEAM DEVICE TO ELIMINATE DETERIORATION IN BEAM CHARACTERISTIC DUE TO MAGNETIC FIELD OF THE CATHODE. Yamazaki, Hatsuo. Japanese Patent 1969-13078. June 12, 1969. Filed June 22, 1964.

Circuits for pulsing a gun-type electron source in synchronism with the accelerating cycle of a linear accelerator are presented. This eliminates the adverse effects of the magnetic field due to the filament heating current and allows higher electron beam intensities to be obtained. (TSS) (NSA of Japan)

49254 DEVICE FOR PRODUCING PULSED MAGNETIC FIELD. Matsui, Isao (to Hitachi Ltd.). Japanese Patent 1969-13354. June 14, 1969. Filed May 7, 1965.

Pulsing circuits for focusing, dispersing, deflecting, and orbit adjusting of pulsed particle beams in accelerators are described. (TSS) (NSA of Japan)

49255 ELECTRON-BEAM IRRADIATION DEVICE. Suganomata, Shinji (to Hitachi Ltd.). Japanese Patent 1969-12798. May 27, 1969. Filed June 21, 1965.

When irradiating high-polymer materials with accelerated electrons to improve the quality, the electrons emerge through an aluminum foil of several-ten to several-hundred microns in thickness, at the end of an accelerating tube. To obtain uniform exposure of the material and also to protect the foil from heat due to the electrons, the electron beam is scanned by two separate devices. By the method proposed, only one power source is necessary, whereas in the conventional method, two power sources are required for the corresponding scanning devices; the result is compactness of the over-all irradiation apparatus. The method is applicable for such charged-particle accelerators as the Cockcroft–Walton's apparatus. For one of the scanning devices, i.e., scanning coils, to supply it with exciting current, part of the current for high-voltage generation in the Cockcroft–Walton's machine is fed to the coil. (NSA of Japan)

49256 ELECTRON-BEAM IRRADIATION DEVICE. Suganomata, Shinji (to Hitachi Ltd.). Japanese Patent 1969-12799. May 27, 1969. Filed June 21, 1965.

When high-polymer materials are irradiated with accelerated electrons to improve the quality, the electrons emerge through an aluminum foil of several-ten to several-hundred microns in thickness, at the end of an accelerating tube. In this case, to have uniform irradiation on the material and also to protect the foil from heat due to the electrons, the electron-beam is scanned by the two individual devices. By the method proposed, one of the two power sources for the corresponding scanning devices can be eliminated, resulting in the compactness of the irradiation apparatus. The method is applicable for such voltage-multiplying devices as the Cockcroft–Walton's apparatus. The Cockcroft–Walton's apparatus is made up by an arrangement of plurality of rectifiers and of condensers; on the high-voltage side, to nullify a floating capacitance, a compensating circuit is installed. The leaking magnetic fluxes from this circuit are utilized to scan the electron-beam, in one direction, at the upper end of the accelerating tube; the other scanning is done at the irradiation end of the accelerating tube, as usual. (NSA of Japan)

49257 CHARGED-PARTICLE ACCELERATING DEVICE. Tsuji, Yoshio (to Sumitomo Electric Industries, Ltd.). Japanese Patent 1969-13359. June 14, 1969. Filed Dec. 26, 1964.

In the charged-particle accelerating device proposed, a Cockcroft–Walton's accelerator, current of the accelerated particles is detected indirectly, and the charged-particle source is automatically controlled accurately and with fast response. The magnetic-modulator technique is used. The charged-particle source at the cathode in the accelerating tube is controlled by signals from this current detector. To detect the current of charged particles, the same magnetic-modulator technique is used. The output current or voltage of the adjuster, connected to the current detector, is converted into air pressure with a static relay. This signal of air pressure is sent through an insulated pipe to the cathode of the accelerating tube, where the air pressure is converted again into electrical signal. The charged-particle source is controlled by the electrical signal. (NSA of Japan)

49258 CALCULATION OF LIMITING CURRENT IN PROTON LINEAR ACCELERATORS. Vlasov, A. D. At. Energ. (USSR), 27: 238-40(Sept. 1969). (In Russian).

A brief review is given on published data calculations of limiting proton current in a linear accelerator. A more convenient formula for limiting current was obtained, shifting of equilibrium phase was taken into account, and correlations were made of theoretical and experimental data. Theoretical and experimentally obtained currents are tabulated for linear accelerators I-2, I-100, CERN, and AGS. (R.V.J.)

49259 SYSTEM FOR TIME-OF-FLIGHT MEASUREMENTS ON FAST NEUTRONS. Le Rigoleur, C.; Abramson, D. (CEN, Cadarache, France). Rev. Phys. Appl., 4: 253-4(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

An experimental set-up, located near the 5-MeV pulsed and bunched Van de Graaff at Cadarache operated by a CII 90-10 computer and intended for neutron time-of-flight measurements is described. It includes five fast neutron detectors and various monitors. In addition a precession electromagnet was designed for neutron polarization measurements. (auth)

48260 SIL'NOTOCHNYI BETATRON I STEREOBETATRON. (High-Current Betatron and Stereobetatron). Vorob'ev, A. A.; Moskalev, V. A. Moscow, Atomizdat, 1969. 104p.

The book is devoted to the developments of new induction accelerators; high-current betatrons and stereobetratrons. The main topics examined were: equipment and exploitations of high-current betatrons, estimating and obtaining required magnetic fields in accelerators, high-voltage system for injection of electrons in accelerators, and transport system for bundles of accelerated electrons from equilibrium orbit to targets. At the end of the book materials are given for magnetic field corrections in double-chamber stereobetatrons and methods for obtaining homogeneous axial magnetic fields which do not require subsequent correction. (tr-auth)

49261 RESEARCH ON INTENSE MAGNETIC FIELDS OF SUPERCONDUCTORS FOR EXPERIMENTS IN PARTICLE PHYSICS. Massue, J. P.; Royer, J.; Eberle, H.; Oppel, R.; Braun, H. (Centre de Recherches Nucleaires, Strasbourg). Rev. Phys. Appl., 4: 230-2(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

The construction of pulsed superconducting coils is described. The time of a pulse is about a msec. The internal diameter is of the order of 10 mm and the fields of about 400 kG. (auth)

49262 SUPERCONDUCTING MAGNETS FOR PARTICLE PHYSICS. Desportes, H. (CEN, Saclay, France). Rev. Phys. Appl., 4: 233-4(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

The present status of superconducting magnets is briefly reviewed, in view of existing or possible applications in high energy physics. An example is given in the polarized target Hera magnet. (auth)

49263 SCATTERING CHAMBER WITH DIFFERENTIAL PUMPING. Wery, M.; Seltz, R.; Magnac-Valette, D. (CRN, Strasbourg). Rev. Phys. Appl., 4: 235(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

A scattering chamber using a differential pumping system is described. Twelve solid state detectors and their slit system assembly can be rotated with respect to the beam center line. (auth)

49264 LIQUID TRITIUM TARGET. Chemarin, M.; Feuvrais, L.; Gouanere, M.; Lemaire, M. C.; Nicolai, G. (Institut de Physique Nucleaire, Lyon). Rev. Phys. Appl., 4: 236-7(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

A liquid tritium or deuterium target of small size, 0.4 cm^3 liquid tritium in which 27-MeV dueterons lose 1.4 MeV, is described. (auth)

49265 DESCRIPTION OF A GASEOUS TARGET OF ^{11}B (OR ^{10}B). Chanut, Y. (Institut d'Etudes Nucleaires, Algiers); Perrin, C.; Gilot, B. Rev. Phys. Appl., 4: 237-8(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

A gaseous target of isotopic boron in which the gas enclosed in the scattering chamber is B_2H_6 is described. The contamination with carbon, nitrogen, and oxygen compounds is very slight. This gaseous target can be used also under differential pumping. (auth)

49266 CONVERSION OF A 12-MeV TANDEM TO 15 MeV. Delaunay, B. (CEN, Saclay, France). Rev. Phys. Appl., 4: 161-2(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

A comparative study of accelerators has been made with the aim of increasing the energy of the tandem. Information is given on the 12 MeV-15 MeV conversion. (auth)

49267 INJECTOR FOR THE HEAVY-ION LINEAR ACCELERATOR AT ORSAY. Arianer, J.; Debray, P. (Institut de Physique Nucleaire, Orsay, France). Rev. Phys. Appl., 4: 177-8(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

A model ion source was built intended to fit the heavy ion injector of the Orsay Linear Accelerator. The results allow us to design the ultimate elements of the system on the injector platform. (auth)

49268 INTERDIGITAL ACCELERATING STRUCTURE OF TYPE H. Chabert, A.; Veyron, B.; Voisin, G. (Univ., Lyon). Rev. Phys. Appl., 4: 179-80(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

A new type of accelerating structure, namely the H type interdigital structure, seems well suited for heavy ion linear accelerators due to their small transverse dimensions, and good shunt impedance. The main characteristics of this type of structure, including the electrical characteristics and particle dynamics, are given. (auth)

49269 HIGH-FREQUENCY STRUCTURE AND FOCUSING SYSTEM OF THE HEAVY-ION LINEAR ACCELERATOR AT ORSAY. Bieth, C.; Goldstein, Ch. (Institut de Physique Nucleaire, Orsay, France). Rev. Phys. Appl., 4: 181-2(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

The radiofrequency cavity and the focusing system for the heavy ion linac which is being constructed at Orsay, are briefly described. Some results on rf measurements and efficiency of the grids are given. (auth)

49270 BUNCHER WITH SIMULATED THIRD HARMONIC. Goldstein, C.; Laisne, A. (Institut de Physique Nucleaire, Orsay, France). Rev. Phys. Appl., 4: 183-4(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

A high efficiency buncher using the fundamental frequency and its second harmonic to simulate the third one is proposed. The theoretical efficiency of this system is 88% instead of 65% with the classical one. Practically, it is possible to obtain a gain between 4 and 5 instead of 3 with the classical buncher. (auth)

49271 TRIPERIODIC STRUCTURE. Tran Duc Tien; Epsztein, B. (CSF, Orsay, France). Rev. Phys. Appl., 4: 185-6(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

It is well known that the accelerating structure using travelling waves operates with better efficiency at a $2\pi/3$ mode than at a $\pi/2$ mode. It is the same, in standing wave operation, it can be shown that the triperiodic structure should be more efficient than the biperiodic one. Performances obtained from experimental structures of both kinds are presented. (auth)

49272 MACROTRON: A CONTINUOUS WAVE ACCELERATOR OF 100 kW. Epsztein, B.; Pinel, J. (CSF, Orsay, France). Rev. Phys. Appl., 4: 187-8(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

The Macrotron is an electron accelerator in which the beam crosses a large number of times the accelerating gap of an rf cavity fed by CW power at meter wavelengths. It delivers a beam of high average power and very good optical quality. (auth)

49273 STUDY ON SUPERCONDUCTING PARTICLE ACCELERATORS. Kervizic, J. (CSF, Orsay, France). Rev. Phys. Appl., 4: 188-9(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

Some results on superconducting rf cavities, as a first step in their application to particle accelerators are presented. The study under way concerns a phase-locked accelerating field device. The main features for an electron linear accelerator are also given. (auth)

49274 TRANSPORT OF A BEAM OF HEAVY IONS FROM THE LINEAR ACCELERATOR TO THE CYCLOTRON AT ORSAY. Ah-Hot, L. (Institut de Physique Nucleaire, Orsay, France). Rev. Phys. Appl., 4: 189-90(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

The optical elements necessary for the transfer of the beam coming from the linear accelerator to the stripping-target in a cyclotron, which is located on the equilibrium orbit of injected heavy ions, are discussed. (auth)

49275 EXPERIMENTAL ASPECTS OF COUPLING AN ELECTRON LINEAR ACCELERATOR WITH A PULSED REACTOR. Fraysse, G. (CCR-EURATOM, Ispra, Italy). Rev. Phys. Appl., 4: 192-4(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

The use of an electron linac to shorten the pulse duration of a reactor is described. The problems involved make it necessary to bring in new concepts: high peak intensity standing wave linac, large dimension electron gun, high power density target, achromatic beam handling system, etc. (auth)

49276 CONTROL OF A VAN DE GRAAFF AND EXPERIMENTS BY A COMPUTER. Bluet, J. C.; Leroy, J. L.; Fardeau, P. (CEN,

Cadarache, France). Rev. Phys. Appl., 4: 129-30(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

A CII 90-10 computer has been associated with the 5-MeV Van de Graaff accelerator at Cadarache. Energy and directly related quantities are controlled. Concerning the experiments, the functions of the system are acquisition of data, and control of all the parameters. Software problems are more particularly discussed. (auth)

49277 PROGRAM OPTICS: CALCULATIONS OF PARTICLE BEAM TRANSPORT. Carbonel, B. (Institut de Physique Nucleaire, Orsay, France). Rev. Phys. Appl., 4: 165-6(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

The program Optics: calculates a particle beam transport through optical elements (magnetic lenses and magnets), with phase ellipses; plots radial and vertical envelopes of beam; determines, by iteration, blocks of four unknown gradients in magnetic lenses; and enables simultaneous fixing of the positions and widths of images. (auth)

49278 MEASUREMENT OF INSTANTANEOUS ENERGY STABILITY OF AN ACCELERATOR. Gerber, J.; Vivien, J. P.; Macher, A.; Armbruster, R. (Institut de Recherches Nucleaires, Strasbourg). Rev. Phys. Appl., 4: 167-8(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

A time-of-flight analysis using UHF electric fields giving the energy stability of a Van de Graaff beam has been made. (auth)

49279 IONIZER WITH HIGH EFFICIENCY FOR ATOMIC BEAMS. Bruandet, J. F.; Ripouteau, F.; Fruneau, M. (Institut des Sciences Nucleaires, Grenoble, France). Rev. Phys. Appl., 4: 169-70(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

To produce polarized neutrons by the T(d,n)α reaction, from polarized deuterons, an ionizer with high efficiency has been built. A beam of 4×10^{15} polarized atoms, on 2.5 cm^2, is given by an atomic deuterium source at ground potential. The ionizer works at 150 kV, and the measurement of the ionization efficiency in D^+ is at least 10^{-3}. The ion beam emittance measured at 4 keV is less than 800 mm × mr. (auth)

49280 MODIFICATION OF SOURCE AND INJECTION SYSTEM FOR NEGATIVE IONS FOR A TANDEM. Delaunay, B.; Girma, J. L. (CEN, Saclay, France). Rev. Phys. Appl., 4: 171-2(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

Several modifications have been made at the tandem to obtain ^3He beams. The analyzed current is 230 nA, 18 MeV ^3He with charge-exchange in hydrogen. (auth)

49281 SOURCE OF POLARIZED PROTONS FOR A TANDEM. Delaunay, B. (CEN, Saclay, France). Rev. Phys. Appl., 4: 172-4(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

A polarized ion source has been built. It has given 0.5 to 2 nA of H^- in the tests. (auth)

49282 RADIATION SAFETY AT HIGH ENERGY ACCELERATORS. Knyazev, V. A.; Komochkov, M. M.; Lebedev, V. N.; Meshcherova, I. V.; Mosharov, A. I. At. Energ. (USSR), 27: 210 (Sept. 1969). (In Russian).

The state and problems of radiation safety at high energy accelerators are characterized using the example of proton synchrotrons 7, 10 and 70 GeV. The main radiation factors of the accelerators 7 and 10 GeV with the current up 10^{10} protons sec^{-1} are fast neutrons ($0,1 < E < 20$ MeV) and the particles of high energies ($E > 20$ MeV). The intermediate neutrons and gamma radiation may achieve considerable quantity and must also be taken into account. Contamination of air environment is not important. The methods of the measurements of the ionization radiation fields around the accelerators are indicated. In the conclusion, the main directions of the further developments of works in the radiation safety region at high energy accelerators are formulated. (auth)

49283 REPORT ON THE SERPUKHOV 70 GeV PROTON SYNCHROTRON. Kuznetsov, E. P. (Inst. of High Energy Physics, Serpukhov, USSR). pp 847-55 of Methods in Subnuclear Physics. Vol. III. Nikolic, M. (ed.). New York, Gordon and Breach Science Publishers Inc., 1969.

A general review of the state of the individual assemblies of the Serpukhov 70-GeV synchrotron is presented. The injector, injector system, ring accelerator, beams, and planned experiments are described. (J.F.P.

49284 DOSE RATES AND FIELD HOMOGENEITY OF SIEMENS 42 MeV BETATRON. Rassow, Juergen (Ruhr Univ., Essen). Acta Radiol., Ther., Phys., Biol., 8: 331-42(Aug. 1969).

The maximum dose rates for the 42 MeV betatron in the range of photon and electron energies within 5 and 43 MeV, and all field sizes and homogenizing filters, were determined. Half-value scatter angles and thicknesses of scatter foils are discussed. A comparison is made of the energy dependence and absolute values of maximum dose rates of the Siemens 42 MeV betatron and the BBC 35 MeV betatron. (auth)

49285 ESTIMATE OF REVERSIBLE MAGNETIC FOCUSING OF ELECTRON BEAMS. Bakhrakh, L. E.; Kozel, I. A.; Murzin, V. V. Radiotekh. Elektron, 13: 1708-11(Sept. 1968). (In Russian).

Previous studies on the behavior of electron beams in reversible magnetic fields and the influence of this type of field on further motion of electrons resulted in equations solved on computers for radial motion of boundary electrons in laminar flow in the order of regimes of reversible magnetic focusing; different approximate methods of analysis of reversible focusing were developed, based on linearization of the indicated equations. In this study it seems, that for investigation of the behavior of electron beams in the area of reversible magnetic fields, accuracy sufficient for engineering practice is possible by use of the method of successive approximations using only the first approximation equation of the differential equation of movement of boundary electrons. The application of this method is illustrated by the estimate of trajectories of electrons in reversible magnetic fields, and also, by consideration of the regime of optimum focusing to any degree of screening. (tr-auth)

49286 RESPONSE TIME OF ION BEAMS IN A PIG ION SOURCE. Cheon, Beonguk; Kotani, Kouichi; Suita, Tokuo (Osaka Univ.). J. Phys. Soc. Jap., 27: 1022-7(Oct. 1969).

The response time (τ) of hydrogen ion beam is investigated with a modified Phillips Ionization Gauge (PIG) ion source by applying the ratio frequency. The control electrode is biased at 70 volts negative with respect to the source plasma and modulated by the radio frequency in the interval of 0.05-15 MHz. The response time is proportional to the square root of the gas pressure (P) and to the reciprocal ion density (n). Moreover the time depends on the amplitude of the radio frequency. These effects on the response time can be explained from the recovery time of the perturbed ion density written as $\tau = 250(PE)^{\frac{1}{2}}/n$ where E is the mean field strength. (auth)

49287 CONSTRUCTION AND CALIBRATION OF A FARADAY CUP. Miyachi, Takashi; Akino, Yoshio (Tokyo Univ.). Genshikaku Kenkyu, 14: No. 1, 52-68(July 1969). (In Japanese).

A Faraday cup has been constructed for the absolute measurements on the external electron beam from the INS 1.3-GeV electron synchrotron. The design, construction and some operational characteristics of the cup in connection with a secondary emission monitor (SEM) as a comparative monitor are described. (auth) (NSA of Japan)

49288 APPLICATION OF THE 200 kV ACCELERATOR FOR THE PRODUCTION OF "DRIVE-IN" TARGETS FROM GASEOUS RADIOACTIVE XENON. Ludziejewski, Jerzy; Rurarz, Edward; Sulik, Andrzej; Haratym, Zbigniew (Inst. of Nuclear Research, Swierk, Poland). Nukleonika, 14: 247-51(1969).

A 200 kV Cockcroft–Walton type accelerator was used to produce a radioactive xenon source in aluminium foil. The dependence of the collection of Xe ions in Al on the experimental conditions, e.g., varying energy of ions, current density, and time of target bombardment, was investigated. The value of the saturation activity was found to increase linearly with ion energy, reaching its maximum at about 125 keV and falls rapidly with the further energy increase. It is supposed that this phenomenon may be due to the sputtering effect and radiation damage of the Al crystal lattice. (auth)

49289 INVESTIGATION OF THE FREQUENCY–TIME SPECTRA OF MICROWAVE IMPULSE SIGNALS. Grishaev, I. A.; Mufel, V. B.; Nikitina, T. F. (Physical-Technical Inst. of Low Temperatures, Kharkov). Zh. Tekh. Fiz., 39: 1237-40(July 1969). (In Russian).

Results of an investigation of the frequency–time spectra of pulse generators for a 2-GeV electron linac are presented. A waveguide interferometer with one probe was used to detect instabilities. The causes of frequency spectrum broadening are

discussed, and methods for improving the high-frequency parameters and energy spectrum of the accelerator are considered. (tr-auth)

49290 CREATION OF UNIFORM ELECTRON FIELDS OF IRRADIATION WITH STATIONARY MAGNETIC FIELDS. Belov, V. P. Zh. Tekh. Fiz., 39: 1218-22(July 1969). (In Russian).

The practical application of irradiation by electrons requires electron-optical systems to ensure evenness of irradiation. A simple method for calculating the irradiation intensity distribution on a target is presented. Integral calculations from the electron density distribution function are discussed, and rules for the determination of the integral limits for the target are given. Recommendations for the design of electron-optical systems to produce even fields of irradiation are included. (tr-auth)

49291 ON THE THEORY OF CAPTURE OF PARTICLES IN SYNCHROTRON REGIME. Moroz, E. M. (Lebedev Inst. of Physics, Moscow). Zh. Tekh. Fiz., 39: 1203-8(July 1969). (In Russian).

The coefficient of the capture of a monoenergetic bundle of particles in the synchrotron regime of acceleration upon accurate inclusion and the instantaneous establishment of amplitude of the accelerating voltage was calculated in the form of a product of two multipliers. One of the multipliers depends only on the parameters of the accelerator, the other, on the particle distribution function according to the amplitudes of betatron oscillations. (tr-auth)

49292 ADIABATIC APPROACH IN THE CASE OF SLOW MOVEMENT OF CHARGES IN SPACE-PERIODIC MAGNETIC FIELD. Kovtun, R. I. (Inst. of Radio Engineering and Electronics, Moscow). Zh. Tekh. Fiz., 39: 1215-17(July 1969). (In Russian).

The slow movement of charges in a superposed strong homogeneous field and a periodic cylindrically symmetric space modulation is studied. A modification of the asymptotic method is used which does not allow premises concerning paraxial movements or the smallness of the radius of ρ of the cyclotron orbit. (tr-auth)

PHYSICS (NUCLEAR)

Neutron Interactions with Matter

Refer also to abstracts 47887, 47905, 48058, 49332, 49413, 49541, 49580, and 49581.

49293 (AD–689839) MEASUREMENT OF NEUTRON PENETRATION STANDARDS. VOLUME I. ANGULAR NEUTRON AND GAMMA-RAY SPECTRUM MEASUREMENTS IN A BULK IRON ASSEMBLY. Final Technical Report. Cerbone, R. J.; Miller, J. E.; Profio, A. E. (Gulf General Atomic, Inc., San Diego, Calif.). Mar. 27, 1969. Contract DA-49-146-XZ-482. 91p. (GA–9149(Vol.1); DASA–2289(Vol.1)). CFSTI.

A comprehensive study was made of the neutronic behavior in iron. The research comprised measurements of the neutron angular flux spectrum from approximately 1 keV to 10 MeV in a 76.2-cm-diameter iron sphere, the gamma-ray spectrum from 0.20 to 10.0 MeV in the same bulk assembly, and the gamma-ray time distribution. The neutron angular flux spectra are compared to a series of discrete-ordinates transport calculations using ENDF/B, P3 cross sections in both 29- and 49-group representations. Both calculations indicate that the present ENDF/B data for iron are wrong by as much as fifty percent in some energy regions. (auth) (USGRDR)

49294 (AEEW-M–921) EVALUATION OF THE NEUTRON CROSS-SECTION DATA FOR ZIRCONIUM AND ITS STABLE ISOTOPES IN THE RESOLVED RESONANCE RANGE. Story, J. S.; Pope, A. L. (Atomic Energy Establishment, Winfrith (England)). July 1969. 33p. Dep. CFSTI (U. S. Sales Only). UK 5s.

A new evaluation is presented of the resonance neutron cross sections for natural zirconium and its stable isotopes, with a view to compiling a file of basic tabulated neutron cross-section data. Particular attention has been given to evaluation of the radiation widths for s-wave interactions. Where possible, they have also been derived from measured isotopic resonance integrals or thermal neutron cross-section data. Consequently we are able to represent the resolved resonance region for the natural element up to 6 keV with increased confidence. The resonance absorption integral for dilute natural zirconium appears to be known to about ±10 or 15%. However, more information is desirable on the resonance integrals of the isotopes, and especially for ^{92}Zr and ^{96}Zr for which no measurements have yet been reported. In addition it is noted that: (i) the measured values of the thermal neutron capture cross-sections of the isotopes are not consistent with the data for natural zirconium, in particular the value for ^{91}Zr appears to be too high by nearly a factor of 2; (ii) there is a need for measurements of the radiation widths of all the even isotopes of zirconium. (UK)

49295 (CNEA–243) PERTURBATION OF THE THERMAL FLUX OF NEUTRONS IN CYLINDERS OF GOLD. Barrachina, M.; Radicella, R. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1969. 16p. (In Spanish). Dep. CFSTI (U. S. Sales Only).

The thermal neutron flux perturbations produced by gold samples were determined by irradiating two sets of cylinders of equal height (0.6 cm) and different radii (0.025 to 0.2 cm) in the graphite thermal column of the RA 1 reactor. The average specific activity induced at the surface (A_s) and in the whole volume (A_v) of the cylinders, referred to an ideal standard sample (A_0), allowed the determination of the perturbation factors $H = A_s/A_0$, $G = A_v/A_s$ and $F = A_v/A_0$. The experimental values of F were compared with those calculated according to Nisle, Gilat and Gurfinkel, and Gubbins method. It was found that the total flux perturbation factor F is correctly predicted by the neutron escape probability of the samples, the best fitting estimate obtained by Gubbins equation. (auth)

49296 (JUL–588-FN) INCOHERENT SCATTERING OF SLOW NEUTRONS BY GLOBULAR MOLECULES IN A CUBIC CRYSTAL. I. CALCULATION OF NEUTRON TIME-OF-FLIGHT SPECTRA. II. INTERPRETATION OF SCATTERING DATA FOR ADAMANTANE. Stockmeyer, R.; Hossfeld, F.; Axmann, A. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Festkoerper- und Neutronenphysik). Apr. 1969. 51p. Dep. CFSTI (U. S. Sales Only).

A scattering law for rigid ball-like molecules in a cubic crystal is formulated. Neutron time-of-flight distributions are derived from a scattering cross section, which includes rotational diffusion jumps. Time-of-flight spectra for adamantane were measured at room temperature and compared with calculations using a model with one frequency jump. A FORTRAN listing of the computer program ADAM, for calculating time-of-flight curves, is presented. (J.W.R.)

49297 (KFK–946) STATISTICAL BEAM MODULATION TECHNIQUES IN NEUTRON PHYSICS. Beckurts, K. H. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Kernphysik). Mar. 1969. 16p. Dep. CFSTI (U. S. Sales Only).

Three basic methods are described by which time-of-flight distributions can be measured. The first is to excite a system by short pulses and to observe directly the system response function. The second possibility is to excite the system by a sine wave; then the output yields the Fourier transform of the response function. Finally, it is possible to excite the system by white noise and to form a cross-correlation between input and output. Since the autocorrelation function of a white noise signal is a delta function in time, the output of the cross-correlation process will be the impulse response function. The first method is employed in classical TOF experiments. It is shown that both the second and third methods can be used with neutrons. However, the correlation method is concentrated on. (B.G.D.)

49298 (NP–17997) THERMAL NEUTRON SCATTERING MEASUREMENTS IN WATER. Research and Development Progress Report No. 449. Borgonovi, G. M.; Koppel, J. U.; Young, J. A. (Gulf General Atomic, Inc., San Diego, Calif.). May 1969. Contract 14-01-0001-1705. 59p. GPO.

For Office of Saline Water, Washington, D. C.

The status, quantity, and usefulness of presently available inelastic neutron scattering measurements in water were reviewed. On the basis of this review, it was found that good knowledge of the neutron scattering from water exists only within a limited range of the variables energy and momentum exchanges. A number of suggestions are given for the best experimental and theoretical approach for studying water by means of inelastic slow-neutron scattering. The suggestions include the analysis of the distributions of scattered neutrons instead of the scattering law for some ranges of energy and momentum transfer and the calculation of the cross section with a method that does not require unnecessary approximations. A detailed theoretical analysis of the dynamics of water was performed for the diffusive and vibrational modes. That part of the dynamics which pertains to the rotational modes was correlated to the slow-neutron scattering results and a best estimate for the rotational part of the frequency spectrum was obtained. (auth)

49299 (ORNL-TM–2590) HELENE: COMPUTER PROGRAM TO CALCULATE NUCLEAR CROSS SECTIONS EMPLOYING THE HAUSER–FESHBACH MODEL, PORTER–THOMAS WIDTH FLUCTUATIONS, AND CONTINUUM STATES. Penny, S. K. (Oak Ridge National Lab., Tenn.). Aug. 18, 1969 Contract W-7405-eng-26. 35p. Dep. CFSTI.

HELENE is a computer program, written in FORTRAN, with which one may calculate the differential cross sections for scattering and reactions which proceed through a compound nucleus. The code is limited to binary reactions such as (n,n'), (n,α), etc., but includes a means of calculating capture and a partial disappearance to take into account fission, etc. Continuum states can be included in competition with discrete states. (auth)

49300 (ORNL-TM–2679) SUPERTOG: A PROGRAM TO GENERATE FINE GROUP CONSTANTS AND P_n SCATTERING MATRICES FROM ENDF/B. Wright, R. Q.; Lucius, J. L.; Greene, N. M.; Craven, C. W. Jr. (Oak Ridge National Lab., Tenn.). Sept. 1969. Contract W-7405-eng-26. 78p. Dep. CFSTI.

SUPERTOG is a program to generate fine-group parameters and group-to-group scattering matrices using basic ENDF/B cross section data. A calculation to generate resonance data which uses single level Breit–Wigner resonance parameters is included in the code. The energy group structure, the order of cross section expansion, and the spectral weighting function are arbitrary and can be specified by the user. Data can be generated in forms for use in the GAM-I, GAM-II, ANISN, and DOT programs. Auxiliary programs are available for obtaining library tapes for XSDRN. (auth)

49301 REACTION RATES FROM NUCLEAR REACTOR NEUTRONS. De Neve, Rudi. Meded. Kon. Vlaam. Acad. Weten-Sch. Belg., Kl. Wetensch., 30: No. 2, 1-35(1968).

The interactions of neutrons with matter, the moderation of fission neutrons in a nuclear reactor, and the absorption of neutrons through cadmium are discussed. A survey of different definitions of cross sections and neutron flux conventions is given (Westcott convention, Høgdahl convention, Stoughton and Halperin

convention, equivalent fission flux). A simple expression for the effective cross section of a (n,γ) reaction in a reactor neutron spectrum as a function of the cadmium ratio is derived. A relationship is established between the mean cross section of a (n,p) or (n,α) reaction for fission neutrons and the cross section for 14-MeV neutrons. It was possible to predict the mean cross section within a factor of three from the cross section for 14-MeV neutrons. (auth)

49302 EXPERIMENTAL DETERMINATION OF THE NEUTRON SCATTERING LENGTH OF THE BISMUTH ATOM USING TOTAL REFLECTION FROM A LIQUID BISMUTH MIRROR. Nuecker, Nikolaus (Technsiche Hochschule, Munich). Z. Phys., 227: 152-61(1969). (In German).

The scattering length of the bound bismuth atom was determined to a = $(8.5239 \pm 0.0014) \cdot 10^{-13}$ cm by reflection of cold neutrons (E = 0.0004 eV) from a liquid bismuth mirror at the neutron gravity refractometer at the research reactor of the Technische Hochschule München. The potential scattering length of the bismuth nucleus was calculated to be $R' = (9.47 \pm 0.05) \cdot 10^{-13}$ cm from the measured value of the scattering length allowing for resonance scattering and neutron-electron-interaction. (auth)

49303 VARIATIONAL CALCULATION OF HETEROGENEOUS RESONANCE ABSORPTION. Almalliah, Moyassar Yahia. Madison, Wis., Univ. of Wisconsin, 1968. 307p.

Thesis.

The investigation concerns the calculation of heterogeneous resonance absorption by utilizing the well known Kantorovich variational method to determine the heterogeneous resonance flux and its adjoint for a slab-cell system of fuel and moderator. The basic assumption is that the resonance flux, $\Psi_T(x,\mu,u)$, can be reasonably represented, at any point in the cell, by a linear combination of three infinite-medium spectra: $\Psi_T(x,\mu,u) = C_1(x,\mu) \cdot \phi_1(u) + C_2(x,\mu)\phi_2(u) + C_3(x,\mu) \cdot \phi_3(u)$, where the subscripts refer to: (1) pure absorber with little moderation, (2) pure moderator with little absorption, and (3) a homogeneous mixture of absorber and moderator. After a choice of angular trial functions, a reduced Euler-Lagrange system of twelve ordinary differential equations is obtained, whose solution is the spatial dependence of the heterogeneous flux. It was assumed that the angular dependence of the flux and its adjoint is adequately described by the DP-1 approximation. Since the Euler-Lagrange system is linear, of first order, and with constant coefficients, the solution is of exponential form, and is computed in a straight forward manner using matrix techniques. To generate the resonance cross-sections, the Breit-Wigner form of each individual resonance is employed. To this end, the second order differential equations for the Doppler-broadened line shape functions $\Psi(u,\theta)$ and $\chi(u,\theta)$ are solved numerically. To generate the infinite homogeneous medium spectra, the first order difference–differential equation obtained by differentiation of the usual integral form of the neutron slowing down equation for the case of a mixture of several species of nuclei is solved numerically. The general close agreement in most cases and the minor disagreements in other cases between the results of the variational codes HETRA-I and II and those obtained by the well-known RABBLE code have substantiated the adequacy of the variational model and the reliability of the digital computer codes. The results show that while anisotropic scattering has a minor effect (≲1%) on the value of the resonance integral, I_R, the interference scattering effect has a substantial effect (≈15%) on I_R for some individual resonances. (Diss. Abstr.)

49304 USE OF POLARIZED NEUTRON SCATTERING MEASUREMENTS. Sene, R.; Kahane, J.; Delpierre, P.; Heyman, M. Rev. Phys. Appl., 4: 115(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

An elaborate method for the use of a large number of elementary spectra before their interpretation is described. (auth)

49305 NEUTRON WAVE PROPAGATION EXPERIMENT IN A HETEROGENEOUS SYSTEM OF PLANE LATTICE. Takahashi, Akito; Yoshioka, Ritsuo (Osaka Univ.). J. Nucl. Sci. Technol. (Tokyo), 6: 433-42(Aug. 1969).

Measurements of neutron pulse propagation were carried out in heterogeneous systems of plane lattices constituted of alternate plane layers of graphite and hydrogeneous materials (either paraffin or meta-acrylite). The effective diffusion parameters, diffusion length and diffusion coefficient for neutron propagation parallel and perpendicular to the layers of propagating medium were derived from measured complex relaxation lengths. An elementary method of theoretical analysis is given, based on the P-1 equation with space dependent cross sections. Dispersion laws for parallel and perpendicular propagation are derived in the form of determinants of matrices. The complex inverse relaxation lengths for the experimental systems taken up have been calculated, which ageee fairly well with the experimental results reported in terms of effective diffusion parameters. (auth)

49306 A NUMERICAL METHOD OF THE BOLTZMANN TRANSPORT EQUATION FOR NEUTRON SHIELD IN FINITE CYLINDRICAL GEOMETRY. Takeuchi, Kiyoshi (Ship Research Inst., Tokyo). Senpaku Gijutsu Kenkyujo, 6: 103-16 (May 1969). (In Japanese).

A numerical method is presented for neutron transport calculations by solving the steady state, energy-dependent Boltzmann equation for a finite cylindrical geometry. Anisotropic treatment for the elastic scattering and isotropic treatment for the inelastic scattering are taken into account in the calculation of the scattering integral. The Boltzmann equation was solved with introduction of quasi-cartesian coordinates and with use of the discrete-ordinate-angles in the neutron direction of motion. Good agreements are obtained in the comparisons of MENE calculations with an analytical solution for a constant source distribution, with NIOBE calculations and experimental spectra for neutron transport in water, or with Monte Carlo calculations of neutron angular distributions. (auth) (NSA of Japan)

49307 DATA EVALUATION AND SHAPE DEPENDENCE IN THE PULSED NEUTRON TECHNIQUE. Nielsen, Kjell Walter. Albuquerque, N. Mex., Univ. of New Mexico, 1968. 126p.

Thesis.

Pulsed neutron measurements were performed on H_2O and polyethylene in cylindrical geometry. The main emphasis was on clearing up unexplained discrepancies as reported by others. The use of an extrapolated end point, ϵ, was avoided by using a Marshak boundary condition in the simple diffusion theory. Eigenvalues were calculated in terms of physical dimensions and diffusion coefficient. Percent radial leakage was used to describe systems as tall, symmetric and flat in an effort to determine whether or not a shape dependence exists within the limitations of simple diffusion theory. Various data analysis techniques were investigated in detail. From data obtained independently on H_2O and polyethylene no shape dependence was observed. Diffusion properties for H_2O were found to be $\overline{v\Sigma}_a = 4,700 \pm 90$ sec^{-1}, $\overline{vD}_0 = 35,350 \pm 520$ cm^4/sec, L = 2.74 ± .03 cm, and C = 4,000 ± 620 cm^4/sec. Results for polyethylene were determined to be $\overline{v\Sigma}_a = 5,300 \pm 60$ sec^{-1}, $\overline{vD}_0 = 28,280 \pm 440$ cm^2/sec, L = 2.31 ± .02 cm, and C = 2,640 ± 600 cm^4/sec. (Diss. Abstr.)

49308 SLOWING DOWN OF FAST NEUTRONS IN THIN HYDROGENOUS MODERATORS. Bayer, R. (Nuclear Research Inst., Rez, Czech.). Czech. J. Phys., 19: 1103-26(1969).

The slowing down of neutrons in thin hydrogenous moderators of different thickness and finite lateral dimensions is studied using two experimental methods, a) the direct method of measuring the time distribution of neutrons slowed down to a specified energy and leaving the moderator, b) an indirect method which consists of determining the influence of such a moderator on the resonance width of a known neutron resonance at low energy measured by the time-of-flight neutron spectrometer. The experimental results are compared with Monte Carlo calculations and with theoretical expressions derived elsewhere. Fairly good agreement is obtained between experiment and the Monte Carlo calculations. The theoretical predictions are seen to be of limited range of validity only and especially a great difference between the theoretical and experimental time variance of the slowing-down time is observed. (auth)

49309 ANGULAR POSITION OF THE SIDE MAXIMUM IN THE CRITICAL SCATTERING FOR DIFFERENT NEUTRON WAVELENGTHS. Ciszewski, R. (Warsaw Technical Univ.); Blinowski, K. Phys. Lett., 30A: 68(Sept. 8, 1969).

Neutron small angle scattering in iron at the Curie point for three different wavelengths (λ = 1.14 Å; 1.45 Å; 1.73 Å) has been measured. The angular position of the side maximum moves approximately according to Kociński's predictions. (auth)

49310 STUDY OF A PULSED NEUTRON SOURCE HAVING AN ELECTRODYNAMIC PLASMA ACCELERATOR. Lyamin, Yu. A.; Kholev, S. R. At. Energ. (USSR), 26: 559-60(June 1969). (In Russian).

Two plexiglas sections having a diameter of 60 mm and a length of 490 mm were used in producing intense neutron pulses by a(d,t) reaction. At the beginning of the first section there is a plasma accelerator with a pulsed introduction of deuterium gas. A three microfarad condenser charged to an initial voltage U_0 is connected to the accelerator electrodes. Between the two sections there is a partial plasma attenuator in the form of brass grids (0.1 mm opening) which are connected to each other and grounded. At the end of the second section there is an extracting electrode containing a thick tritium-zirconium target 45 mm in diameter. A 0.5-microfarad condenser with a potential U_m is connected to the extraction

electrode. The initial vacuum was 2×10^{-5} torr. Photometric and probe measurements showed that two plasma bundles are formed with average velocities of $\sim 1.5 \times 10^8$ and 1×10^7 cm/sec. The neutron yield, determined by an activation method, is given as a function of the voltages U_0 and U_m. Two neutron pulses were observed as about 10^{-3} and 10^{-2} seconds after gas injection. High ion currents due to ion acceleration in a non-stationary glow discharge seem to be very promising in the creation of powerful, low-voltage neutron sources. (TTT)

49311 TRITIUM TARGET. Inoue, Minoru (to Hitachi Ltd.). Japanese Patent 1969-12797. May 27, 1969. Filed Mar. 20, 1965.

The tritium target, formed by attaching tritium on the surface of a base plate, and is used for producing neutrons by bombarding with deuterons, has the following advantages: reduction in the evaporation of tritium due to target heating; lengthening of the life of a tritium target because of the increased area of tritium attachment; and possibility of increasing neutron production. The surface of the base plate where tritium is attached, has a number of protrusions, a sharp triangle in cross section, or other variation of similar shapes. In this way, the area of attaching tritium onto the base plate, and then the area of heat radiation are increased; further, the beam of deuterons impinges onto the surface, not at 90 degrees but at much sharper angles. The surface may be simply air-cooled, or cooling water may be used underneath the surface. (NSA of Japan)

49312 DETERMINATION OF THE ENERGY DISTRIBUTION OF NEUTRONS FROM Am–Be AND ^{252}Cf SOURCES WITH THE HELP OF A ^{3}He SEMICONDUCTOR SANDWICH SPECTROMETER. Cloth, P.; Hecker, R. (Kernforschungsanlage, Juelich, Ger.). Nukleonik, 12: 163-8(May 1969). (In German).

In addition to the application of older, well-known measurement techniques to the spectrometry of fast neutrons, in recent years semiconductor detectors have increasingly been used in this kind of measurement. Today the ^{6}Li and ^{3}He semiconductor spectrometers are used. Studies carried out here show, in agreement with other authors, that the ^{3}He semiconductor spectrometer generally gives as reliable measurements as the ^{6}Li spectrometer in the fast energy region. The application of a ^{3}He semiconductor spectrometer to the measurement of the spectra of Am–Be and ^{252}Cf sources is described as well as corrections for various mechanisms which can lead to incorrect results. (tr-auth)

49313 ESTABLISHMENT OF A STANDARD THERMAL-NEUTRON FLUX DENSITY AT THE BHABHA ATOMIC RESEARCH CENTRE. Shahani, M. G.; Sharma, D. (Bhabha Atomic Research Centre, Trombay, India). pp 515-29 of Radiation Protection Monitoring. Vienna, International Atomic Energy Agency, 1969.

From Regional Seminar for Asia and Far East on Radiation Protection Monitoring, Bombay, India. See STI/PUB-199; CONF-681203.

A standard of thermal-neutron flux density has been established for calibrating thermal-neutron detectors. The moderating geometry consists of six ^{241}Am–Be(α,n) source having a total neutron emission rate of 6.6×10^6 n/s and imbedded in a graphite pile (163 cm × 152 cm). The thermal-neutron flux density in a small air cavity (5 cm × 5 cm × 15 cm) at the center of the assembly has been absolutely measured in terms of ^{197}Au neutron capture cross-section by 4-$\pi\beta$–γ coincidence counting of high purity circular gold foils. Various corrections have been applied and sources of errors discussed. The Westcott flux density below cadmiun cut-off energy at the center of the cavity is estimated to be $6454 \pm 1.8\%$ n cm^{-2}s^{-1}. The flux density in the central 5-cm region of the cavity has been found to be constant to better than 0.7% by 4-$\pi\beta$ counting of irradiated Mn–Ni foils. The BARC flux standard has been directly compared with the standards maintained at the National Bureau of Standards, Washington, the Electrotechnical Laboratory, Tokyo, and the Mendeleev Institute for Metrology, Leningrad, by exchanging irradiated gold foils. (auth)

49314 SPECTRA AND DOSES OF NEUTRONS FROM THE REACTORS DURING THEIR PASSAGE THROUGH IRON FILTERS. Stanolov, A.; Kristov, V. Izv. Fiz. Inst. Aneb, Bulg. Akad. Nauk., 18: 99-104(1969). (In Russian).

The spatial distribution of the fast and resonance neutrons from the reactor during their passage through iron filters, placed in one of the horizontal experimental channels of the Experimental Reactor in Sofia was investigated. The spectrum of the resonance neutrons in the 0.46 eV–5800 eV range was investigated with the help of 13 activation detectors. Data for the relaxation lengths of the neutrons with resonance energies 1.46, 4.95 and 132 eV and for fast neutrons with E > 2.78 MeV were obtained. It is shown that an iron filter 50 cm thick increases about 12 times the relative content of resonance neutrons in the reactor neutron beam, which passed through the filter, which is of some interest of practical value for some radiobiological experiments. (auth)

Nuclear Properties and Reactions, A≤ 5

Refer also to abstracts 47793, 47797, 47798, 49034, 49044, 49163, 49398, 49483, 49484, and 49541.

49315 (ANL–7410, pp 1-46) FISSION PROPERTIES AND CROSS SECTION DATA. (Argonne National Lab., Ill.).

ACTINIDES — neutron capture rates in, activation methods for determining (E)
ANTIMONY-123 — neutron elastic scattering at 0.85 MeV, optical-model analysis of polarization in (E/T)
BISMUTH-209 — neutron total cross section at 0.2 to 1.5 MeV (E)
— neutron elastic scattering at 0.2 to 1.5 MeV, cross section for (E)
CADMIUM-112 — neutron elastic scattering at 0.85 MeV, optical-model analysis of polarization in (E/T)
CALCIUM — neutron total cross section at 100 to 650 keV (E)
CARBON — neutron total cross section at 750 to 1550 keV (E)
COPPER-63 — neutron elastic scattering at 0.85 MeV, optical-model analysis of polarization in (E/T)
GADOLINIUM — neutron elastic scattering at 0.4 to 1.6 MeV, cross sections for
HAFNIUM — neutron elastic scattering at 0.4 to 1.6 MeV, cross sections for
— neutron total cross section at 100 to 650 keV (E)
HELIUM — neutron elastic scattering at 1 keV to 100 MeV, cross section for (T)
IRON-56 — neutron elastic scattering at 0.85 MeV, optical-model analysis of polarization in (E/T)
LITHIUM-7 — neutron total cross section at 100 to 1500 keV (E)
MOLYBDENUM-96 — neutron elastic scattering at 0.85 MeV, optical-model analysis of polarization in (E/T)
NICKEL-58 — neutron elastic scattering at 0.85 MeV, optical-model analysis of polarization in (E/T)
NIOBIUM-93 — neutron elastic scattering at 0.85 MeV, optical-model analysis of polarization in (E/T)
PALLADIUM — neutron elastic scattering at 0.2 to 1.5 MeV, cross section for (E)
PLUTONIUM-239 — neutron resonance integrals at 100 to 300 eV, comparison of single-level and multilevel (T)
SAMARIUM — neutron elastic scattering at 0.4 to 1.6 MeV, cross sections for
SELENIUM-80 — neutron elastic scattering at 0.85 MeV, optical-model analysis of polarization in (E/T)
THORIUM-232 — neutron fission of, energy dependence of delayed neutron yield from fast
TIN-120 — neutron elastic scattering at 0.85 MeV, optical-model analysis of polarization in (E/T)
TITANIUM-48 — neutron elastic scattering at 0.85 MeV, optical-model analysis of polarization in (E/T)
URANIUM — neutron total cross section at 650 to 1500 keV (E)
URANIUM-235 — neutron fission of, energy dependence of delayed neutron yield from fast
URANIUM-238 — neutron fission at 1.5 and 5.6 MeV, correlation of mass, energy, and angle in (E)
— neutron fission of, energy dependence of delayed neutron yield from fast
— neutron capture at 10 to 100 keV, cross-section calculation using Monte Carlo code (E/T)
VANADIUM — neutron elastic scattering at 0.4 to 1.6 MeV, cross sections for
— neutron total cross section at 0.1 to 1.4 MeV (E)
YTTRIUM-89 — neutron elastic scattering at 0.85 MeV, optical-model analysis of polarization in (E/T)
ZIRCONIUM-90 — neutron elastic scattering at 0.85 MeV, optical-optical-model analysis of polarization in (E/T)

49316 ELASTIC SCATTERING OF VECTOR POLARIZED DEUTERONS ON ^{4}He. Gruebler, W.; Koenig, V.; Schmelzbach, P. A.; Marmier, P. (Eidgenoessisches Technische Hochschule, Zurich). Nucl. Phys., A134: 686-96(1969).

The vector polarization parameter $\langle iT_{11} \rangle$ of deuterons scattered on ^{4}He was measured using the vector polarized deuteron beam from the ETH tandem accelerator. Measurements were made at c.m. angles between 33.6 and 151° in the energy range of 3 to 11.5 MeV. The results show that d-α scattering is useful as an analyzer for deuteron vector polarization for most deuteron energies in this energy range. (auth)

49317 CORRELATION ENERGY OF ^{4}He. Kuo, T. T. S. (State Univ. of New York, Stony Brook); McGrory, J. B. Nucl. Phys., A134: 633-40(1969).

The correlation energy in the ground state of ^{4}He due to all $2\hbar\omega$ excitations is investigated. An effective residual interaction derived from the Hamada-Johnston potential is used. Contributions from $2\hbar\omega$ excitations are treated to all orders by diagonalization. These contributions are found to be relatively small (≈0.6 MeV/particle). It is found that the calculation is extremely sensitive to the presence of states with spurious center-of-mass motion. The spectrum of negative-parity $1\hbar\omega$ states is calculated with the same interaction. The calculated spectrum is in only qualitative agreement with experiment. (auth)

49318 POLARIZATION OF NEUTRONS FROM (p,n) REACTIONS ON ^{2}D, ^{6}Li, AND ^{7}Li NUCLEI USING INCIDENT POLARIZED PROTONS OF 30 AND 50 MeV ENERGY. Robertson, L. P. (Rutherford High Energy Lab., Didcot, Eng.); Hanna, R. C.; Ramavataram, K.; Devins, D. W.; Hodges, T. A.; Moroz, Z. J.; Hoey, S. J.; Plummer, D. J. Nucl. Phys., A134: 545-60(1969).

The polarization transfer coefficient, α_t, was measured for (p,n) reactions on ^{2}H, ^{6}Li and ^{7}Li using transversely polarized protons incident at energies of 30 and 50 MeV. The transverse polarization of neutrons emitted at 0° was determined by measuring the asymmetry of scattering from a liquid helium scintillator associated with plastic scintillators in a time-of-flight system. Values of α_t obtained for the three targets for the highest energy neutrons were -0.13 ± 0.03, -0.16 ± 0.05 and $+0.15 \pm 0.05$ for 30 MeV and -0.23 ± 0.07, -0.21 ± 0.05 and -0.021 ± 0.04 for 50 MeV incident energy with a further uncertainty of 8% due to the polarimeter analyzing power. Calculations assuming the impulse approximation and using recent n-p scattering phase shifts give reasonable agreement with the data. (auth)

49319 DETECTION OF VERY SMALL (n,γ) ASYMMETRIES WITH POLARIZED NEUTRONS. Forte, M. (EURATOM-CCR, Ispra, Italy). Rev. Phys. Appl., 4: 265-6(June 1969).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

Parity nonconserving admixtures in nuclear states may be revealed from a very small asymmetry in the distribution of gamma-rays emitted after the capture of polarized neutrons in certain nuclei. An experimental accuracy at the limit of present possibilities is required. The criteria followed in developing the methods for reversing the neutron polarization and for the data collection and the control measurements are described. (auth)

49320 SECOND-ORDER CONTRIBUTION TO THE BINDING ENERGY OF ^{4}He AND ^{16}O. Bleuler, K.; Kreuzer, H. J.; Schuette, D. (Univ., Bonn.). Nuovo Cim., Lett., 2: 288-91(Aug. 21, 1969).

The second-order contributions in the perturbation calculation of the binding energies for ^{4}He and ^{16}O are evaluated. All one-particle wave functions were taken to be pure oscillator functions and both Volkov and Hamada-Johnston potentials were used. (J.W.R.)

49321 STUDY OF THE REACTION ^{3}He(d,d)^{3}He AT $1 < E_d < 3$ MeV. Dauchy, A. (Institut d'Etudes Nucleaires, Algiers); Amokrane, A.; Beaumevieille, H.; Morand, C.; Yaker, M.; Nguyen Van Sen. Nuovo Cim., Lett., 2: 263-70(Aug. 21, 1969). (In French).

The differential cross sections and angular distributions for deuteron elastic scattering by ^{3}He at 1 to 3 MeV were measured. An optical model analysis was performed using potential parameters which were used earlier at higher energies. (J.W.R.)

Nuclear Properties and Reactions, $6 \leq A \leq 19$

Refer also to abstracts 47414, 47797, 47798, 47896, 49318–49320, 49349, 49362, and 49398.

49322 (AD–689388) MEASUREMENT OF GAMMA-RAY PRODUCTION CROSS SECTIONS FOR NITROGEN AND OXYGEN. Final Report. Orphan, V. J.; Hoot, C. G. (Gulf General Atomic, Inc., San Diego, Calif.). Jan. 31, 1969. Contract DASA01-68-C-0016. 98p. (GA–8006; DASA–2267). CFSTI.

A gamma-ray production cross section measurement facility is described in this report. This facility uses a LINAC as a neutron source and a Ge(Li) as the gamma detector. The facility was used to measure the gamma-ray production cross sections of nitrogen and oxygen for incident neutron energies of up to 16 MeV. The results are tabulated, graphed, and compared with other measurements. (auth) (USGRDR)

49323 (AD–689433) A DIRECT MEASUREMENT OF PARTICLE-HOLE IMPURITIES IN THE GROUND STATE OF ^{16}O. Purser, K. H.; Alford, W. P.; Cline, Alford D.; Fulbright, H. W.; Gove, H. E. (Rochester Univ., N. Y. Nuclear Structure Research Lab.). Mar. 1969. Contract AF49(638)-1707. 25p. (UR-NSRL–16; AFOSR–69-1617-TR). CFSTI.

The pickup reactions ^{16}O(d,t)^{15}O and ^{15}O(d,He-3)^{15}N were investigated at a deuteron energy of 20 MeV to allow a direct measurement of the two-particle two-hole admixtures in the ground state wave function of ^{16}O. The results give good evidence for the existence of such pair excitations with intensities comparable to those predicted by Brown and Green. (auth) (USGRDR)

49324 (AD–689434) STRUCTURE OF LOW-LYING STATES IN A = 15 NUCLEI. Alford, W. P.; Purser, K. H. (Rochester Univ., N. Y. Nuclear Structure Research Lab.). Apr. 1969. Contract AF49(638)-1707. 25p. (UR-NSRL–17; AFOSR–69-1618-TR). CFSTI.

States in ^{15}O up to 8.32 MeV excitation have been studied in the ^{14}N(^{3}He,d)^{15}O reaction at 14 MeV. States in ^{15}N up to 6.33 MeV excitation were observed in the reaction ^{14}C(^{3}He,d)^{15}N at the same energy. Angular distributions were measured between 10 degrees and 40 degrees lab, and 1 values and spectroscopic factors were obtained by comparison with DW calculations. The results have been compared with the results of several calculations for A = 14 ground state wave functions. Spectroscopic factors for transitions to even parity states in A = 15 nuclei are in excellent agreement with calculations of Halbert and French. (auth) (USGRDR)

49325 (AD-690246) DECAY SCHEMES OF ^{18}Ne, ^{22}Mg, AND ^{38}Ca FROM (^{3}He,n-γ) MEASUREMENTS. Shapiro, M. H.; Adams, A.; Moss, C.; Denny, W. M. (Rochester Univ., N. Y. Nuclear Structure Research Lab. California Inst. of Tech., Pasadena). May 1969. Contract Nonr-220(47). 56p. (UR-NSRL-20). CFSTI.

The associated gamma-ray time-of-flight technique was used to investigate the principal decay modes of several low-lying levels in ^{18}Ne, ^{22}Mg and ^{38}Ca via the (^{3}He,n gamma) reaction. Neutron-gamma coincidence data obtained in this manner was used to limit the possible spin-parity assignments to these levels. (auth) (USGRDR)

49326 (ANU-P–443) SEARCH FOR THE LOWEST T = 2 STATE OF ^{8}Be: EXPERIMENTAL. Black, J. L.; Caelli, W. J.; Livesey, D. L.; Watson, R. B. (Australian National Univ., Canberra. Research School of Physical Sciences). [1969]. 7p. Dep. CFSTI (U.S. Sales Only).

An anomaly with width T = 10 ± 3 keV was observed in the excitation functions for ^{6}Li + d reactions at an excitation energy in ^{8}Be of 27.483 ± 0.010 MeV. It is interpreted as being due to the isospin forbidden excitation of the lowest T = 2 state of ^{8}Be. (auth) (Australia)

49327 (ANU-P–448) PROTON INDUCED REACTIONS IN ^{18}O FROM 3.00 TO 7.00 MeV. Din, G. U. (Australian National Univ., Canberra. Research School of Physical Sciences). [1969]. 21p. Dep. CFSTI (U. S. Sales Only).

Excitation functions for the ^{18}O(p,p′γ), ^{18}O(p,α′γ)^{15}N, and ^{18}O(p,n′γ)^{18}F reactions were measured by observing simultaneously yields of 0.940-, 1.045-, 1.080-, 1.98-, and 5.30-MeV gamma-rays from the decay of the excited states of the final nuclei as a function of proton energy from 3.00 to 7.00 MeV. The yield curves show resonances corresponding to energy levels in ^{19}F with excitation energies between 10.8 and 14.3 MeV. (auth) (Australia)

49328 (ANU-P–458) THE 1080 keV RESONANCE OF THE ^{15}N(p,αγ) REACTION. Cloud, S. D.; Ophel, T. R. (Australian National Univ., Canberra. Research School of Physical Sciences). 1969. 12p. Dep. CFSTI (U.S. Sales Only).

The spins of levels in ^{16}O excited by the ^{15}N(p,$\alpha_1\gamma$) reaction for proton energies between 898 and 1640 keV were derived from measurements with a Ge(Li) detector. Angular correlations, extracted from the Doppler-broadened profiles measured at each resonance, confirm that the spins of the 898-, 1210-, and 1640-keV resonances are 2^-, 3^-, and 1^+, respectively, and enable an assignment of 1^- to the weak, broad resonance at approximately 1080 keV. (auth) (Australia)

49329 (BNL-tr–281) KNOCK-OUT OF FAST ^{3}He FRAGMENTS FROM LIGHT NUCLEI BY 665-MeV PROTONS. Komarov, V. I.; Kosarev, G. E.; Savchenko, O. V. (Joint Inst. for Nuclear Research, Dubna (USSR)). Translated by Stephen J. Amoretty (Brookhaven National Lab., Upton, N. Y.). from report JINR–P1-4373. 20p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 23: 25812.

49330 (BNL-tr–282) QUASIELASTIC SCATTERING OF 665-MeV PROTONS BY ALPHA-PARTICLE CLUSTERS IN LIGHT

NUCLEI. Komarov, V. I.; Kosarev, G. E.; Savchenko, O. V. (Joint Inst. for Nuclear Research, Dubna (USSR)). Translated by S. J. Amoretty (Brookhaven National Lab., Upton, N. Y.), from report JINR-P1-4227. 17p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 23: 19157.

49331 (CEA-CONF-1326) ^{16}O STATES FROM THE ^{13}C(^{6}Li, t)^{16}O REACTION AT 20 MeV. Bassani, G.; Saunier, N.; Traore, B. M. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires); Kruse, T. H. (Rutgers Univ., New Brunswick, N. J.). [1969]. 1p. (CONF-690804-2). Dep. CFSTI (U. S. Sales Only).

From International Conference on Properties of Nuclear States, Montreal, Canada.

The energy spectra and angular distribution of tritons in the reaction ^{12}C(^{6}Li,t)^{16}O at 20 MeV are reported. The energy levels of ^{16}O, including a possible new one, are examined. (B.G.D.)

49332 (EANDC(E)-115(U)) PROGRESS REPORT ON NUCLEAR DATA RESEARCH IN THE EURATOM COMMUNITY FOR THE PERIOD JANUARY 1-DECEMBER 31, 1968. (European-American Nuclear Data Committee. European-American Committee on Reactor Physics). Mar. 1969. 255p. (In several languages). Dep.

COPPER-63 — neutron reactions (n,2n) at 14 to 18 MeV, cross sections for (E)
COPPER-65 — neutron reactions (n,2n) at 14 to 18 MeV, cross sections for (E)
DYSPROSIUM — neutron total cross section for, cold (E)
ERBIUM — neutron total cross section for, cold (E)
FISSION FRAGMENTS — charge, energy, and mass distributions of, from uranium-235 neutron fission (E)
FISSION PRODUCTS — delayed neutron yields of, from uranium-235 thermal fission (E)
GOLD-198 — energy level scheme for (E)
HOLMIUM-165 — neutron total cross section for, cold (E)
KRYPTON-91 — decay scheme (E)
LITHIUM-6 — neutron reactions (n,p) at 3 to 9 MeV, excitation function for (E)
— neutron inelastic scattering at 4 to 7 MeV, excitation function for (E)
LITHIUM-7 — neutron inelastic scattering at 14 MeV, n-γ coincidence spectra for (E)
LUTETIUM — neutron total cross section for, cold (E)
MANGANESE-55 — neutron reactions (n,2n) at 14 to 18 MeV, cross sections for (E)
MERCURY-200 — energy level scheme for (E)
NEODYMIUM — neutron capture at 120 to 600 eV, time-of-flight spectra for (E)
NEUTRONS, THERMAL — scattering lengths in various elements and organic liquids (E)
NIOBIUM-93 — neutron reactions (n,α) at 14 MeV, angular distributions for (E)
NIOBIUM-99 — decay scheme (E)
NIOBIUM-100 — decay scheme (E)
NIOBIUM-101 — decay scheme (E)
OXYGEN-16 — neutron reactions (n,α) at 14 MeV, angular distributions for (E)
— energy level at 10.94 MeV, lifetime of (E)
PLUTONIUM-239 — neutron fission at 5 to 1000 keV, relative cross section for (E)
POTASSIUM-41 — neutron reactions (n,p) at 14 to 18 MeV, cross sections for (E)
RHODIUM-103 — neutron reactions (n,α) at 14 MeV, angular distributions for (E)
SAMARIUM-153 — energy level scheme for (E)
SCANDIUM-45 — neutron total cross section at 16 to 107 keV (E)
SELENIUM-84 — decay scheme (E)
SILVER-107 — neutron reactions (n,α) at 14 MeV, angular distributions for (E)
TERBIUM-159 — neutron total cross section for, cold (E)
THULIUM-169 — neutron total cross section for, cold (E)
URANIUM-233 — neutron fission at 5 to 1000 keV, relative cross section for (E)
— neutron total cross section at 43 to 96 eV (E)
YTTRIUM-97 — decay scheme (E)
ZINC-64 — neutron reactions (n,p) at 14 to 18 MeV, cross sections for (E)
— neutron reactions (n,2n) at 14 to 18 MeV, cross sections for (E)
ZINC-66 — neutron reactions (n,2n) at 14 to 18 MeV, cross sections for, (E)
ZIRCONIUM-99 — decay scheme (E)
ZIRCONIUM-101 — decay scheme (E) (J.W.R.)

49333 TENSOR POLARIZATION AND REACTIONS OF DEUTERONS ON ^{16}O AT BOMBARDING ENERGIES OF 4.4 TO 8.4 MeV. Cords, H.; Din, G. U.; Robson, B. A. (Australian National Univ., Canberra). Nucl. Phys., A134: 561-76(1969).

The spin tensor moments $\langle T_{20}\rangle$, $\langle T_{21}\rangle$, and $\langle T_{22}\rangle$ of deuterons from ^{16}O-d elastic scattering were measured as a function of angle at an average deuteron bombarding energy of 6.34 MeV using the ^{3}He(d,p)^{4}He reaction as an analyzer. Absolute cross sections for the reactions ^{16}O(d,d)^{16}O, ^{16}O(d,p)^{17}O (ground state and 0.871 MeV state) and ^{16}O(d,α)^{14}N (ground state) were obtained as a function of angle at 5.755, 6.260 and 6.765 MeV and as a function of energy between 4.385 and 8.430 MeV for several angles. An analysis of these measurements was performed using the optical model and the distorted-wave and Hauser-Feshbach theories. (auth)

49334 PROTON-INDUCED REACTIONS IN ^{18}O FROM 3.00 TO 7.00 MeV. Din, G. U. (Australian National Univ., Canberra). Nucl. Phys., A134: 655-66(1969).

Excitation functions for the ^{18}O(p,p'γ), ^{18}O(p,$\alpha'\gamma$)^{15}N and ^{18}O(p,n'γ)^{18}F reactions were measured by observing simultaneously yields of 0.940, 1.045, 1.080, 1.98 and 5.30 MeV gamma rays from the decay of the excited states of the final nuclei as a function of proton energy from 3.00 to 7.00 MeV. The yield curves show resonances corresponding to energy levels in ^{19}F with excitation energies between 10.8 and 14.3 MeV. (auth)

49335 ANALYSIS OF THE ^{6}Li(p,pd)^{4}He REACTION. Jain, A. K. (Bhabha Atomic Research Centre, Bombay); Sarma, N.; Banerjee, B. Nuovo Cim., 62B: 219-28(Aug. 11, 1969).

A fully antisymmetrized cluster-model wave function for ^{6}Li is used for calculating the matrix element of the reaction ^{6}Li(p,pd)^{4}He. The calculations are carried out in plane-wave impulse approximation and the effect of the various terms arising from antisymmetrization is discussed. (auth)

49336 LIFETIMES BY DOPPLER SHIFT USING SOLID AND GASEOUS STOPPING MEDIA. Kavanagh, R. W.; Schulz, N.; Merdinger, J. C. (Institut de Recherches Nucleaires, Strasbourg). Rev. Phys. Appl., 4: 215-16(June 1969).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

Lifetime values or limits for low-lying levels in ^{33}S, ^{38}Ar and ^{40}K have been found from γ-ray Doppler shift attenuation (DSA) in Au, Cu, and C solids, and for levels in ^{33}S and ^{43}Ca by DSA in Xe and Ar gases at various pressures up to 30 kg/cm^2. (auth)

49337 MEASUREMENT OF MEAN LIFETIMES BY THE DOPPLER EFFECT. Gallmann, A.; Haas, F.; Heusch, B.; Toulemonde, M. (Centre de Recherches Nucleaires, Strasbourg). Rev. Phys. Appl., 4: 216-17(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

Lifetimes of nuclear states have been obtained by the Doppler shift attenuation method. The γ-rays were detected in lithium-drifted germanium counters. Lifetimes of the ^{12}B 0.953 MeV and the ^{14}N 6.44 MeV levels are reported. (auth)

49338 HIGH RESOLUTION INVESTIGATION OF RESONANCES IN ^{19}F. Sellin, David L.; Newson, Henry W.; Bilpuch, Edward G. (Duke Univ., Durham, N. C.). Ann. Phys. (N. Y.), 51: 461-75(Feb. 15, 1969).

The ^{18}O(p,p)^{18}O and ^{18}O(p,α)^{15}N excitation functions were investigated in the energy range E_p = 1.39 to 3.20 MeV by simultaneous observation of protons and α-particles at 135°. Only twelve prominent elastic scattering levels were observed at this angle and at 45°, despite the high experimental resolution (less than 400 eV energy spread). Only one resonance was observed for the proton interaction with ^{16}O under the same conditions. R-matrix expressions for multichannel multilevel cross sections were programmed and used to analyze these data. Three of the resonances were determined to be s-wave and seven d-wave, while only two were found to have odd parity. Spins were assigned to each of these twelve resonances except for one d-wave. (auth)

49339 SHELL-MODEL INTERPRETATION OF THE RESONANCES IN ^{19}F. Sellin, David L.; Beres, William P.; Bilpuch, Edward G. (Duke Univ., Durham, N. C.). Ann. Phys. (N. Y.), 51: 476-89(Feb. 15, 1969).

The experimental energies and widths of the resonances in ^{19}F are compared with those of a shell-model calculation. This model predicts positive parity 2p-1h states that are formed by treating the target ^{16}O as the core. It is assumed that these doorway states fragment via couplings with more complex configurations. Except for the 840-keV $\frac{1}{2}^+$ resonance, each positive parity level with strong proton width observed experimentally up to 3.2 MeV can be associated with a doorway state. Both the data and the model indi-

cate that the $\frac{5}{2}^+$ level observed at 2.768 MeV may be identified as the analog of the 3.16-MeV level in ^{18}O; however, isobaric spin impurities are present. (auth)

49340 CIRCUITS AND PROGRAMS FOR HANDLING NUCLEAR DATA. Kuchela, Kavudavadi S. Montreal, McGill Univ., 1968. 81p.

Thesis.

Circuits and programs developed for a nuclear data handling system designed around a PDP-8 computer are described. The circuits represent the necessary interface to the computer and specialized input/output devices. An example of such an input device is the successive approximation type ADC. Successive approximation ADC emphasizes integral rather than differential linearity. A simple method based on the signal averaging process used to extract information from a noisy signal, has been developed to reduce differential non-linearity. The technique has been successfully applied to the design of a 12-bit ADC. Programs developed for the data obtained with Ge(Li) detector and 12-bit ADC permit an experimenter to display and manipulate data in many different ways by the use of light pen and computer switch register, and to determine photopeak positions and intensities. Most of these techniques are also applicable to other types of data obtained in nuclear physics. A shell model calculation in the continuum is performed by diagonalizing an effective interaction on a subset of discrete particle-hole states. The single particle Hamiltonian consists of a Woods–Saxon potential, a spin-orbit interaction, and an average Coulomb field. The effective interaction is a delta function particle-hole interaction and a Coulomb particle-hole force. The reactions studied are: $^{16}O(\gamma,n)^{15}O$, $^{16}O(\gamma,p)^{15}N$, and $^{15}N(p,n)^{15}O$. Ten channels are included explicitly. The effects of the eliminated channels are approximated by using the reduced K matrix which is defined here. The spectrum of particle-hole states for $J^\pi = 0^-$, 1^-, 2^-, and 3^- is compared with experiment and with previous calculations. Mixing through virtual states with one particle in the continuum is calculated. The resonance states are shifted down in energy. For the W = 1 states this counteracts the effect of the particle-hold interaction and therefore, makes the calculation less sensitive to the parameters in the interaction. The mixing through the continuum also causes a complete breakdown of analog spin at 17 MeV excitation in ^{16}O. The Coulomb particle hole interaction reduces the repulsion of the average Coulomb field and therefore lowers the resonance energies. The reaction cross sections are also compared with experiment and with other calculations. The decay of the particle-hole compound states to positive parity states of ^{15}N and ^{15}O increases the widths so that much of the structure is washed out. The giant dipole states overlap to produce one broad background peak in the photonuclear cross section. Therefore we cannot identify the particle-hole compound states with specific experimental peaks. The origin of the observed structure remains an open question. (Diss. Abstr.)

49341 CALCULATIONS FOR ^{10}He NUCLEI. Baz, A. I.; Demin, V. F.; Zhukov, M. V. (Inst. of Atomic Energy, Moscow). Yadern. Fiz., 9: 1184-91(June 1969). (In Russian).

The binding energy of the not yet discovered nucleus ^{10}He is calculated and shown to depend very essentially on certain details of the nucleon-nucleon interactions that are unknown until now. The reasons of this fact are elucidated and its general consequences for problems in nuclear physics are discussed. (auth)

49342 A STUDY OF THE ^{6}Li(n,p)^{6}He REACTION IN THE IMPULSE APPROXIMATION. Mahalanabis, J. (Saha Inst. of Nuclear Physics, Calcutta). Nucl. Phys., A134: 376-84(1969).

The (n,p) and (p,n) reaction in ^6Li was studied using the impulse approximation. Shell-model wave functions yield good shape fit to the experimental data for the (n,p) reaction at 152 MeV, although the magnitude fit is not satisfactory. Assuming the two-nucleon interaction to be known in the impulse approximation an attempt was made to analyze the results to test the validity of the wave functions. (auth)

49343 ^{8}Be PARAMETERS FROM $\alpha-\alpha$ SCATTERING. Kermode, Mark W. (McMaster Univ., Hamilton, Ont.). Nucl. Phys., A134: 336-46(1969).

Effective-range formulas and R-matrix theory are used to investigate the ground state and first two excited states of ^8Be. It is found that an interaction radius of 4.6 fm gives the following energy levels: g.s. (0^+), 3.03 MeV (2^+) and 11.4 MeV (4^+) with observed widths (reduced widths) of 6.14 eV (0.84 MeV), 1.44 MeV (0.96 MeV) and 3.97 MeV (0.97 MeV), respectively. For reactions of the type X(a,b)^{8}Be, it is found that the energy spectrum of particle b has peaks corresponding to excitation energies in ^8Be of 2.9 MeV and 11.15 MeV for the 2^+ and 4^+ states. The small shift in these energies is a result of the energy dependence of the penetration factor. It is pointed out that the present experimental data favor a two-channel description of s-wave $\alpha-\alpha$ scattering in the region of the resonance. (auth)

49344 ELASTIC SCATTERING OF ^{3}He PARTICLES BY ^{9}Be AND ^{11}B BETWEEN 4.0 AND 18.0 MeV. Park, J. Y. (North Carolina State Univ., Raleigh); Duggan, J. L.; Miller, P. D.; Duncan, M. M.; Dangle, R. L. Nucl. Phys., A134: 277-88(1969).

Angular distributions for the ^3He elastic scattering by ^9Be at 4, 6, 8, 10, 15 and 18 MeV and by ^{11}B at 8, 10, 12, 15 and 18 MeV have been measured. The elastic scattering data were analyzed in terms of the optical model including spin-orbit coupling. Surface and volume absorption form factors for the central imaginary part have been examined with and without spin-orbit interaction. Good fits were obtained using either volume or surface absorption. Inclusion of the spin-orbit coupling is found to improve the fits, particularly at higher energies. Ambiguities in the optical-model potentials are found and discussed. The energy dependence of the parameters is investigated and general trends of the potential parameters are found. Average energy dependent potentials for ^9Be and ^{11}B have been deduced. (auth)

49345 SOME LIFETIMES IN THE A = 15 TO 25 MASS RANGE. Nickles, R. J. (Univ. of Wisconsin, Madison). Nucl. Phys., A134: 308-20(1969).

The mean lifetimes of twenty excited states in $^{15,16}N$, $^{16,17,18,19}O$, $^{19,20}F$, $^{19,20,21,22}Ne$, $^{23,25}Na$ and ^{25}Mg were measured by means of the plunger technique. The levels were fed by several-nucleon transfer reactions employing beams of ^{14}N and $^{16,17,18}O$ incident on targets of $^{6,7}Li$, ^9Be and ^{10}B. An integral transform technique was used to fit measured fractional stopped/total ratios using the detailed flight-peak line shape as measured by a Ge(Li) detector at 0°. The measured lifetimes compared to their single-particle estimates showed M1 retardation by one to two orders of magnitude and considerable E2 enhancement. The ground state transitions from the mirror pair ^{19}Ne(275 keV) and ^{19}F(109.8 keV) both show equal E1 retardation. (auth)

49346 NEUTRON ENERGY DETERMINATIONS. Davis, J. C.; Noda, F. T. (Univ. of Wisconsin, Madison). Nucl. Phys., A134: 361-8(1969).

Neutron energies in the range 3 to 8 MeV were measured to 0.1% accuracy. The effects of energy losses in targets and gas cell entrance windows were investigated. Narrow resonances in the interaction of fast neutrons with light nuclei were located with neutrons from the $^2H(p,n)$, $^7Li(p,n)$ and $^2H(d,n)$ reactions. (auth)

49347 BETA DECAY OF ^{10}C. Brown, D. R.; Ferguson, S. M.; Wilkinson, D. H. (Univ. of Washington, Seattle). Nucl. Phys., A135: 159-69(1969).

The decay of ^{10}C is studied using a Ge(Li) detector with a view to determining the branching ratio to the $J^\pi = 1^+$ 2.15 MeV state of ^{10}B. This branch is found to be of $(6.4 \pm 2.0) \times 10^{-3}$% corresponding to log ft = 4.8 ± 0.15. Comparison with the speed of the analogue M1 transition between the 2.15 and 1.74 MeV states of ^{10}B shows that the contributions to the M1 matrix element from the spin and orbital operators are approximately equal and are of the same sign. This disagrees strongly with the predictions of the Cohen–Kurath wave functions; the possibility is explored, following Warburton et al., that better wave functions for the first two $J^\pi = 1^+$ states of ^{10}B (the one studied here and that at 0.72 MeV) may be given by appropriate linear combinations of the Cohen–Kurath wave functions. Good agreement with the beta decay and its M1 analogue is indeed found for a mixture close to that found by Warburton et al., to satisfy certain other transitions involving the $J^\pi = 1^+$ states. (auth)

49348 CHARGED PHOTOPARTICLES FROM ^{9}Be. Adler, Jan-Olof; Forkman, Bengt (Univ. of Lund, Sweden. Lund Inst. of Tech., Sweden). Ark. Fys., 38: 389-402(1968).

An investigation of the photodisintegration process in ^9Be, involving the emission of charged photoparticles, was carried out using an analyzing magnet and nuclear emulsions. A 28-MeV bremsstrahlung beam was used. By combining the analyzing power of the magnetic field with grain counting of the tracks in the emulsions, an improved particle discrimination was obtained. The energy spectrum of the photoprotons was measured, showing that not only the ground and first excited states but also higher excited states in ^8Li were populated. The ratio between the (γ,d) and (γ,p) yields was determined as 0.10 ± 0.04. The result was compared to theoretical calculations of the non-statistical photodeuteron process and also to earlier investigations of the (γ,d) reaction in ^9Be and to (d,γ) experiments on ^{11}B. The comparison showed good agreement indicating a non-statistical photodeuteron emission process for light nuclei in the giant resonance region. The triton to proton yield ratio was estimated to be less than 0.10. The measured energy spectrum of the photo-alphas showed that the main

part derived from a splitting of the ^{8}Be nucleus excited to about 17 MeV. (auth) (Sweden)

Nuclear Properties and Reactions, $20 \leq A \leq 89$

Refer also to abstracts 47745, 47797, 47798, 48998, 49018, 49073, 49074, 49184, 49315, 49319, 49325, 49331, 49332, 49345, 49346, 49398, 49430, 49461, and 49541.

49349 (AD-689840) MEASUREMENT OF NEUTRON PENETRATION STANDARDS. VOLUME II. HIGH RESOLUTION MEASUREMENTS OF THE TOTAL NEUTRON CROSS SECTIONS OF NITROGEN AND IRON. Final Technical Report. Carlson, A. D.; Cerbone, R. J.; Willoughby, D. F. (Gulf General Atomic, Inc., San Diego, Calif.). Mar. 27, 1969. Contract DA-49-146-XZ-482. 123p. (GA-9149(Vol.2); DASA-2289(Vol.2)). CFSTI.

A comprehensive study has been made of the neutronic behavior in iron. The gamma-ray spectrum from 0.20 to 10.0 MeV in bulk assembly, and the gamma-ray time distribution was measured. In addition, the total cross section of iron was measured from 0.5 MeV to 10 MeV with a 0.035 nsec/m resolution. The present ENDF/B data for iron are wrong by as much as fifty percent in some energy regions. (auth)(USGRDR)

49350 (ANU-P-454) DIFFERENTIAL CROSS SECTIONS FOR THE REACTION ^{26}Mg(^{3}He,α)^{25}Mg MEASURED AT E_{τ} = 10.2 MeV. Nurzynski, J. (Australian National Univ., Canberra. Research School of Physical Sciences). [1969]. 18p. Dep. CFSTI (U. S. Sales Only).

A tabulation is given of the differential cross sections for the reactions ^{26}Mg(^{3}He,α)^{25}Mg leading to the ground and excited states in ^{25}Mg, as measured with a beam of 10.2-MeV ^{3}He particles from a tandem accelerator. The target was magnesium enriched to 98.22% of the ^{26}Mg isotope. (Australia)

49351 (ANU-P-455) THE 4.41 AND 4.51 MeV LEVELS OF ^{27}Al. Carter, K. W.; Kean, D. C.; Piluso, C. J.; Spear, R. H. (Australian National Univ., Canberra. Research School of Physical Sciences). [1969]. 16p. Dep. CFSTI (U. S. Sales Only).

The 4.41- and 4.51-MeV levels of ^{27}Al were studied via angular correlation measurements of the reaction ^{24}Mg(α,pγ)^{27}Al. These levels are found to have spins of $^{5}/_{2}$ and $^{11}/_{2}$, respectively. The multipole mixing ratios for the 4.41 to 0, 4.41 to 1.01, 4.51 to 2.21, and 4.51 to 3.00 MeV transitions are $-0.02^{+0.13}_{-0.08}$, $+0.15 \pm 0.13$, -0.05 ± 0.15, and $-0.60^{+0.13}_{-0.08}$, respectively. (auth) (Australia)

49352 (ANU-P-461) THE DEPENDENCE OF THE SPECTROSCOPIC FACTORS ON PARAMETERS OF DISTORTING POTENTIALS FOR THE REACTION ^{26}Mg(τ,α)^{25}Mg. Nurzynski, J. (Australian National Univ., Canberra. Research School of Physical Sciences). [1969]. 29p. Dep. CFSTI.

Angular distributions of α-particles from the reaction ^{26}Mg(^{3}He,α)^{25}Mg studied at $E_{^{3}He}$ = 10.2 MeV were analyzed in terms of DWBA. To avoid the necessity of introducing a lower cut-off radius in the calculation of radial integrals, deep potentials were used. Changes in the potential of the incident particles are found to have only a small influence on the calculated distributions. The fits to the experimental data can be optimized by readjusting one parameter only, namely the depth of the real part of the optical-model potential for α-particles. The present analysis indicated that the dependence of the ratio of the spectroscopic factors $S(l,j)/S_{g.s.}$ (l,j) on the exit channel parameters is weaker (by a factor of from 0.5 to 0.2) than the dependence of the absolute value of the calculated cross sections on the same parameters. The experimental value of the normalization coefficient D_{lj}^{2} obtained here for the (^{3}He,α) reactions is 22 ± 6. (auth) (Australia)

49353 (CEA-R-3590) DATA PROCESSING IN GAMMA SPECTROMETRY. APPLICATION TO THE DECAY SCHEMES STUDY. Boulanger, Jean-Pierre (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). June 1969. 256p. (In French). Dep. CFSTI (U. S. Sales Only).

Thesis. Submitted to Univ. of Paris, Orsay, France.

The purpose of this thesis is the processing of the data issued from a gamma spectrometer, and its applications to the decay schemes study. The mathematical analysis of the full energy peaks, in connection with the very good resolution of semiconductor detectors, leads to a very accurate determination of the energies. The resolution of complex spectra by the least squares method, completed by a spectra generating process, allows the calculation of branching ratios. Then, the handling of the two dimensional experiments permits the coincidence exam. For each of these methods, the calculation principle, then the systematics tests realized in order to prove their validity and to determine their application ranges as well as some experimental results appropriate to illustrate their possibilities, are presented. The energies of some nuclides, frequently used as standards have been thus measured and the decay schemes of ^{134}Cs and ^{110m}Ag determined precisely. (auth)

49354 (ISSP-A-371) NUCLEAR SPIN-SPIN EFFECT IN THE TOTAL CROSS SECTION FOR 1-MeV POLARIZED NEUTRONS ON POLARIZED ^{59}Co NUCLEI. Nagamine, Kanetada; Uchida, Akira; Mikuni, Akira; Suzuki, Takenori; Imaizumi, Minoru; Kobayashi, Shinroku; Kobayashi, Shinsaku (Tokyo Univ. (Japan). Inst. for Solid State Physics). July 1969. 59p. Dep. CFSTI (U. S. Sales Only).

Measurements of the spin-spin effect, $\sigma_{ss} = (\sigma\uparrow\uparrow - \sigma\uparrow\downarrow)/2P_n \cdot P_t$, in the total cross section for polarized neutrons on polarized ^{59}Co are reported at the neutron energies of 1.1 and 1.4 MeV. The degree of target polarization from 0.47 to 0.30 was obtained for a polycrystalline metal of $Co_{0.90} - Fe_{0.10}$ alloy at demagnetization temperatures from 0.030 to 0.048°K. The results of σ_{ss} are -190 ± 140 mb at 1.1 MeV and -150 ± 180 mb at 1.4 MeV. If σ_{ss} is assumed to arise from a spin-orbit term in the optical potential of the form $-V_{ss}\, f(r)\vec{\sigma} \cdot \vec{l}$, the strength of the potential is 200 keV < V_{ss} < 800 keV combining with the published data for σ_{ss} at 7.90 MeV assuming f(r) as a microscopic form factor. A weak and attractive nature of the spin-spin interaction is qualitatively explained by a microscopic model. (auth)

49355 (JAERI-1183) AVERAGE LEVEL SPACINGS AND THE NUCLEAR LEVEL DENSITY PARAMETER. Baba, Hiroshi; Baba, Sumiko (Japan Atomic Energy Research Inst., Tokyo). May 1969. 41p. Dep. CFSTI (U. S. Sales Only).

The average level spacing D_0 was computed with neutron resonance capture data summarized in BNL-325, and compared with those given by several authors. The values thus fixed with reliability were plotted versus the neutron number to see the systematic behavior of the D_0. The less reliable or ambiguous group of the D_0's was then fixed by taking the systematics into consideration. It was also decided from the systematics that the error involved in the D_0's would be at most of the order of a factor of two. The level density parameter α was calculated with the fixed value of the level spacing D_0. The effect of an alternative choice of the level density formula or the moment of inertia on α was discussed and its dependence on the nuclear radius parameter was studied as well. (auth)

49356 (UCRL-71831) THRESHOLD PHOTONEUTRON CROSS SECTIONS AND ANALOG STATES. Berman, B. L.; Baglan, R. J.; Bowman, C. D. (California Univ., Livermore. Lawrence Radiation Lab.). June 27, 1969. 8p. (CONF-690816-3). Dep. CFSTI.

From Gordon Conference for Photonuclear Reactions, Tilton, N. H.

The threshold photoneutron cross sections of ^{52}Cr, ^{56}Fe, and ^{25}Mg were measured at 135° in order to determine the isobaric analog excitation energies. For ^{52}Cr and ^{56}Fe, the spectra were very rich and relatively few $T_>$ levels were seen in the many $T_<$ levels. For ^{25}Mg, the T = $^{3}/_{2}$ analog of ^{25}Na was identified at an excitation energy in ^{25}Mg of 7.8728 ± 0.0030 MeV. (J.W.R.)

49357 BETA-GAMMA (CP) CORRELATION MEASUREMENTS ON ^{55}Co AND ^{52}Mn. Sawyer, Jerry Albert. Davis, Calif., Univ. of California, 1968. 145p.

Thesis.

The beta-gamma (CP) correlation, where CP = circularly polarized, was measured in the decays of ^{55}Co and ^{52}Mn using the well known Compton scattering technique for ^{55}Co and the photon transmission technique for ^{52}Mn. The circular polarization of the gamma rays was measured by observing the change in the beta-gamma coincidence rate resulting from the dependence of the photon-electron scattering cross section on the relative orientation of the photon and electron spins (approximately 7.9 per cent of the electrons are polarized in magnetized iron, the medium where the photon-electron scattering occurs). The correlation measurement yields an asymmetry parameter, called A, which depends upon the states involved and their nuclear properties. The nuclear properties are expressed quantitatively as the matrix elements (Fermi, Gamow-Teller, charge-dependent) of the beta interaction operators and the electromagnetic multipole operators (EL/ML) between the states involved in the beta-gamma cascade. Since the matrix elements are also a function of the spins of the states involved, our measurements can determine the spin, as in the ^{55}Co measurement. The transmission experiment measures the circular polarization of the transmitted photons in contrast to the scattered photons in the ^{55}Co experiment. The transmission experiment on ^{52}Mn gave an A = -.027 ± .009, in close agreement with two recent scattering and two oriented nuclei experiments, but disagreeing significantly with earlier (before '65) results. This work averaged with four other experiments yields for ^{52}Mn:

$\langle A \rangle = -.025 \pm .002$; the matrix element ratio $\langle y \rangle = -.042 \pm .003$, which agrees well with the Kelly and Moszkowski theoretical value (−.04); the Fermi matrix element $\langle M_F \rangle = (5.81 \pm .47) \times 10^{-3}$; the isospin impurity coefficient $\langle \alpha \rangle = (2.91 \pm .24) \times 10^{-3}$; the charge-dependent matrix element $\langle H_c \rangle = 17 \pm 1.3$ keV. It would appear that this should help considerably in resolving the experimental contradictions for ^{52}Mn. ^{52}Mn results were corrected for non-zero instrumental effects ($A = +.005 \pm .004$) and normalized to ^{60}Co (a pure Gamow–Teller transition, $A = -1/3$). (Disser. Abstr.)

49358 ENERGY LEVELS IN ^{33}P. Hardie, G. (Western Michigan Univ., Kalamazoo. Argonne National Lab., Ill.); Holland, R. E.; Meyer-Schuetzmeister, L.; Kuchnir, F. T.; Ohnuma, H. Nucl. Phys., A134: 673-85(1969).

The energies of many levels in ^{33}P were obtained by a magnetic spectrograph analysis of the protons from the ^{30}Si$(\alpha,p)^{33}$P reaction. Proton-gamma angular correlations were studied in the same reaction. Several gamma-decay branching ratios were determined. It was found that the 3.50-MeV state has a spin of $\frac{3}{2}$ or $\frac{5}{2}$, and the 3.63-MeV state has a spin of $\frac{7}{2}$. It is argued that the parity of the 3.63-MeV state is positive and that $\frac{7}{2}^-$ is the most likely assignment for the 4.23-MeV state. Mixing ratios of several transitions were also obtained. (auth)

49359 BETA–GAMMA (CP) CORRELATION AND GAMMA SPECTROSCOPY IN ^{27}Mg. Bigoni, R. A.; Bloom, S. D.; Tirsell, K. G. (Univ. of California, Davis. Univ. of California, Livermore). Nucl. Phys., A134: 620-32(1969).

The β-decay of ^{27}Mg was studied by Ge(Li) γ-ray spectroscopy and by $\beta-\gamma$ (CP) correlation measurements. The intensities lead to β-branching ratios of 72.1 ± 0.4% and 27.9 ± 0.4% through the 1015-keV and the 844-keV states, respectively, and also yield the γ-branching of 3.05 ± 0.15% from the 1015-keV level through the 844-keV level. Using a transmission polarimeter, the asymmetry parameter $A = -0.103 \pm 0.040$ for the $\frac{1}{2}^+ \xrightarrow{\beta} \frac{3}{2}^+ \xrightarrow{\gamma} \frac{5}{2}^+$ decay was obtained. This leads to the value $\langle E2 \rangle / \langle M1 \rangle = -0.322 \pm 0.034$ for the 1015-keV γ-ray. This transmission datum in conjunction with that obtained using a scattering polarimeter gave $A = -0.221 \pm 0.019$ for the $\frac{1}{2}^+ \xrightarrow{\beta} \frac{1}{2}^+ \xrightarrow{\gamma} \frac{5}{2}^+$ decay. This yields $C_V\langle M_V \rangle / C_A \langle M_A \rangle = 0.007 \pm 0.046$ for the 844 keV γ-ray, which corresponds to a Coulomb matrix element of 9 ± 53 keV between the analog of the ^{27}Mg ground state and the 844-keV state of ^{27}Al. (auth)

49360 INELASTIC SCATTERING OF 100 MeV PROTONS FROM Mg AND Si USING A Ge(Li) TOTAL ABSORPTION PROTON COUNTER. Horowitz, Y. S.; Sherman, N. K.; Bell, R. E. (McGill Univ., Montreal). Nucl. Phys., A134: 577-98(1969).

A cooled Ge(Li) detector was used as the total absorption proton counter for the energy analysis of 100-MeV protons scattered from targets of enriched magnesium (99.7% ^{24}Mg) and silicon (natural isotopic composition). A total energy resolution of 400 keV (FWHM) was achieved; it is comparable to the best resolution presently attainable with magnetic spectrometers in the 100 to 200 MeV energy region. The measurements cover the 10 to 60° lab angular region; and angular distributions are presented for 23 peaks in the energy spectra. A qualitative discussion of the excited states which correspond to the observed peaks is based mainly on the shapes of the distributions. Comparisons are made with results from similar experiments at 55 MeV and 185 MeV. Shapes of angular distributions for strongly excited 2^+, 3^- and 0^+ transitions are independent of energy, but significant differences exist for 4^+ transitions. The excitation of a previously unknown level in ^{28}Si at 11.45 ± 0.12 MeV energy was observed. The level most probably has $J^\pi = 5^-$. (auth)

49361 THE 4.41 AND 4.51 MeV LEVELS OF ^{27}Al. Carter, K. W.; Kean, D. C.; Piluso, C. J.; Spear, R. H. (Australian National Univ., Canberra). Nucl. Phys., A134: 505-12(1969).

The 4.41- and 4.51-MeV levels of ^{27}Al were studied via angular correlation measurements of the reaction ^{24}Mg$(\alpha,p\gamma)^{27}$Al. These levels are found to have spins of $\frac{5}{2}$ and $\frac{11}{2}$, respectively. The multiple mixing ratios for the 4.41 MeV → 0, 4.41 → 1.01 MeV, 4.51 → 2.21 MeV and 4.51 → 3.00 MeV transitions are −0.02, +0.15 ± 0.13, −0.05 ± 0.15 and −0.60 ± 0.15, respectively. (auth)

49362 GAMMA-RAY TRANSITIONS IN ^{20}F FROM THE REACTION ^{19}F(d,pγ)^{20}F. Holtebekk, T.; Tryti, S.; Vamraak, G. (Univ. of Oslo). Nucl. Phys., A134: 353-60(1969).

Single γ-ray spectra and proton-gamma coincidence spectra from the reaction ^{19}F(d,pγ)^{20}F were investigated with a Ge(Li) spectrometer. Precise excitation energies were determined for levels up to 4083 keV. New information is obtained on the decay of the 3176- and 4083-keV levels. (auth)

49363 HARTREE–FOCK CALCULATIONS WITH WOODS–SAXON BASIS FUNCTIONS. Ford, William F.; Braley, Richard C. (Lewis Research Center, Cleveland). Nucl. Phys., A134: 265-76(1969).

The Hartree–Fock method is used to study the doubly even N = Z nuclei in the 2s–1d shell. Basis functions with correct asymptotic behavior are generated by use of a Woods–Saxon well. The results are compared with calculations using the conventional harmonic oscillator basis. It is found that most of the Woods–Saxon results may be reproduced with a harmonic oscillator basis if the oscillator parameter is carefully chosen. (auth)

49364 j-DEPENDENCE IN l = 1 TRANSITIONS IN Cr(d,p) REACTIONS. Delic, G.; Robson, B. A. (Australian National Univ., Canberra). Nucl. Phys., A134: 470-80(1969).

The j-dependence of several l = 1 transitions in the ^{50}Cr(d,p)^{51}Cr and ^{52}Cr(d,p)^{53}Cr reactions at 7.5 and 8.0 MeV deuteron bombarding energy, respectively, was qualitatively described using the distorted-wave theory. This description required a rather different deuteron potential from that obtained by fitting elastic-scattering data which implies that the distorted-wave theory is not strictly valid. If the deuteron parameters are essentially the same for each transition, the angular distributions for $J = \frac{1}{2}$ and $J = \frac{3}{2}$ levels are systematically different at backward angles, and the difference is a consequence of the deuteron and proton spin-orbit interactions. The Lee–Schiffer rule may be interpreted in this manner. The transition to the 1.895-MeV level in ^{51}Cr is found to violate the j-dependence rule probably because of unusually large corrections occurring in this case. (auth)

49365 ELASTIC AND INELASTIC SCATTERING OF 14.7 MeV NEUTRONS FROM ^{28}Si. Hoehn, J. (Technical Univ., Dresden); Pose, H.; Seeliger, D.; Reif, R. Nucl. Phys., A134: 289-307(1969).

Differential cross sections in an angular region from 17.2 to 143.2° in the lab system for both elastic and inelastic neutron scattering by ^{28}Si were measured at an incident energy of 14.7 MeV using the pulsed-beam time-of-flight technique. The collective 2^+ (Q = −1.77 MeV) level and the weakly excited 3^+ (Q = −6.27 MeV) state with non-normal parity could be resolved, while the observed peaks at 4.80 MeV and 6.88 MeV correspond to unresolved 4_1^+, 0^+ and 3^-, 4_2^+ states, respectively. The elastic-scattering data were analyzed using the local optical model in its conventional form. The inelastic scattering results were interpreted with DWBA method using the collective model as well as a microscopic description based on a Gaussian effective interaction and spherical nuclear wave functions of the one-particle–one-hole model. (auth)

49366 LEVEL STRUCTURE OF ^{58}Co. Trier, A. (Univ. de Chile, Santiago); Rapaport, J.; Belote, T. A.; Dorenbusch, W. E. Nucl. Phys., A134: 396-406(1969).

The ^{57}Fe(^{3}He,d)^{58}Co reaction was investigated at 10.5 MeV bombarding energy using the MIT multiple-angle spectrograph. A DWBA analysis was carried out on the angular distributions for levels below an excitation energy of 3.7 MeV to determine l_p values and transition strengths. These results are analyzed in terms of shell-model sum rules and are used to describe the ^{57}Fe target configuration. A level scheme for ^{58}Co is proposed. (auth)

49367 ANALOG STATES IN ^{49}V FROM THE REACTION ^{48}Ti(p,γ)^{49}V. II. Klapdor, H. V. (Univ., Hamburg). Nucl. Phys., A134: 419-32(1969). (In German).

The strong resonances at 1007–1013, 1362 and 1388 keV proton energies in the reaction ^{48}Ti(p,γ)^{49}V, which occur at the correct energies to be the isobaric analogue states of the 1384-, 1724-, and 1762-keV states in ^{49}Ti, respectively, were studied by measuring γ-ray spectra and angular distributions of several primary γ-transitions with a Ge(Li) detector. Spins and parities of the first three resonances were determined to be $\frac{3}{2}^-$, $\frac{5}{2}^-$ and $\frac{1}{2}^-$, respectively. For the levels at 3743, 3912, 4003 and 4085 keV excitation energy in ^{49}V, the most probable mixing ratios indicate $\frac{3}{2}^-$, $\frac{5}{2}^-$, $\frac{1}{2}^-$ and $\frac{5}{2}$, respectively. The resonances at 1007 and 1013 keV prove to be the split analogue state of the 1384-keV state in ^{49}Ti. Assuming that the strongest $T < p_{\frac{1}{2}}$ components are populated by the primary M1 radiation, the $T < p_{\frac{1}{2}}$ centroid in ^{49}V is determined to be at 2.3 MeV excitation energy. The Lane term in the optical potential then is $V_1 = 107$ MeV. (auth)

49368 THE (^{3}He,d) AND (^{3}He,p) REACTIONS TO STATES IN ^{54}Mn. Lynn, L. L.; Dorenbusch, W. E.; Belote, T. A.; Rapaport, J. (Massachusetts Inst. of Tech., Cambridge). Nucl. Phys., A135: 97-115(1969).

The ^{53}Cr(^{3}He,d)^{54}Mn and the ^{52}Cr(^{3}He,p)^{54}Mn reactions have been investigated at 10.0 MeV and 11.0 MeV bombarding energies, respectively, using the MIT multiple-gap spectrograph. Transitions from the (^{3}He,d) reaction were observed up to an excitation energy of 5.56 MeV. Levels in this excitation range, as well as the transition to the isobaric analogue of the ^{54}Cr ground state (6.147 MeV), were observed in the (^{3}He,p) reaction. The results for both reac-

tions were analyzed in the distorted-wave Born approximation. (auth)

49369 A STUDY OF LEVELS IN ^{25}Mg BY THE ^{24}Mg(d,pγ)^{25}Mg AND ^{25}Mg(p,p′γ)^{25}Mg REACTIONS. Sowerby, B. D.; Sheppard, D. M.; Olsen, W. C. (Univ. of Alberta, Edmonton). Nucl. Phys., A135: 177-92(1969).

Angular correlation studies of the ^{24}Mg(d,pγ)^{25}Mg reaction at E_d = 3.95 MeV have been carried out using Method II of Litherland and Ferguson. The deduced spins of the 2.801, 3.970 and 4.353 MeV levels are $^3/_2$, $^7/_2$ and $^5/_2$ respectively. The spins and parities of the 4.277, 5.005, 5.108 and 5.742 MeV levels are shown to be $(^1/_2, ^3/_2)^-$, $(^5/_2, ^5/_2, ^7/_2)$, $(^1/_2, ^3/_2)$ and $(^5/_2, ^7/_2)$, respectively; the γ-decay suggests $J^\pi(5.245) = ^9/_2^-$ or $^{11}/_2^+$. The γ-ray branching ratios have been measured for 15 levels in ^{25}Mg ranging in excitation from 1.61 to 6.43 MeV and the mixing ratios have been determined for some transitions. A study of the decay of the 2.738 MeV level using the ^{25}Mg(p,p′γ)^{25}Mg reaction yielded probable E2/M1 mixing ratios of $-0.47^{+0.1}_{-0.2}$ and 2.9 ± 0.5 for the 2.738 → 1.960 and 2.738 → 0 MeV transitions respectively. (auth)

49370 ELASTIC SCATTERING OF 23 MeV ALPHA PARTICLES ON ^{40}Ca. Labie, E.; Lega, J.; Macq, P. C. (Univ. of Louvain, Belg.). Nucl. Phys., A135: 145-52(1969).

The differential cross section for the elastic scattering of 23.07 MeV α-particles on ^{40}Ca has been measured between 14° and 179° laboratory angles. The data are analyzed in terms of the Regge-pole and optical models. The l = 10 angular momentum of the previously observed resonance at 24 MeV is confirmed. (auth)

49371 SOME CALCULATIONS OF NEUTRON CAPTURE CROSS SECTIONS. Chaubey, A. K.; Sehgal, M. L. (Aligarh Muslim Univ., India). Indian J. Phys., 42: 567-70(Sept. 1968).

Neutron capture cross sections were calculated for about 30 cases at 24 keV, using low-energy resonance parameters. These cross sections were compared with previously measured values of the cross sections. In most of the cases, except at neutron magic numbers, a good agreement was found between the experimental and the theoretical values. (auth)

49372 COULOMB EXCITATION OF THE FIRST EXCITED STATE OF ^{28}Si. Pelte, D.; Haeusser, O.; Alexander, T. K.; Hooton, B. W.; Evans, H. C. (Chalk River Nuclear Labs., Ont.). Phys. Lett., 29B: 660-2(Aug. 18, 1969).

A mean life $\tau_m = 0.73 \pm 0.05$ ps and a static quadropole moment $Q = 0.22 \pm 0.09$ b were measured for the first excited state of ^{28}Si by studying the Coulomb excitation of ^{28}Si with 60 MeV ^{32}S ions. (auth)

49373 ISOBARIC SPIN DEPENDENCE IN PROTON TRANSFER REACTIONS. Couch, R. G. (Oak Ridge National Lab., Tenn.); Perey, F. G.; Biggerstaff, J. A.; Seth, K. K. Phys. Lett., 29B: 657-9(Aug. 18, 1969).

Results of an experimental investigation of ^{54}Fe(d,n)^{55}Co reaction are presented and spectroscopic strengths for both $T_<$ and $T_>$ states are derived. It is concluded that within the limits of experimental and analytical uncertainties there is no discrepancy between the spectroscopic factors for $T_>$ analogue states as derived from the (d,n) and (^{3}He,d) reactions. (auth)

49374 EXCITATION AND GAMMA DECAY OF $(f_{\frac{7}{2}}, d_{\frac{3}{2}}^{-1})$ T = 1 AND T = 2 STATES IN ^{42}Ca. Tellez, A.; Ballini, R.; Delaunay, J.; Fouan, J. P. (CEN, Saclay, France). Phys. Lett., 29B: 655-6 (Aug. 18, 1969).

The γ-rays following the decay of particle-hole states in ^{42}Ca were investigated with the reaction ^{41}K(^{3}He,dγ)^{42}Ca. A doublet near 4.10 MeV and a triplet near 4.44 MeV were resolved in a ^{42}Ca (p,p′γ)^{42}Ca experiment. (auth)

49375 LIFETIME OF THE SECOND EXCITED STATE OF ^{21}Na. Anttila, A.; Bister, M. (Univ. of Helsinki). Phys. Lett., 29B: 645-6(Aug. 18, 1969).

The mean lifetime of the second member of the ground-state rotational band in ^{21}Na has been determined as $\tau_m = 45^{+18}_{-18}$ fs with the Doppler-shift attenuation method in the ^{20}Ne(p,γ)^{21}Na reaction. Targets used for the measurements were prepared by implanting Ne ions into tantalum. The effect of the neon and tantalum composition on the lifetime result and some problems associated with lifetime analysis have been treated too. (auth)

49376 OPTICAL PUMPING OF SHORT LIVED β-RADIOACTIVE ISOTOPES AND THE MAGNETIC MOMENT OF ^{37}K. Koepf, U.; Besch, H. J.; Otten, E. W.; von Platen, Ch. . (Univ., Heidelberg). Z. Phys., 226: 297-327(1969).

^{21}Na($T_{\frac{1}{2}}$ = 23 sec) and ^{37}K($T_{\frac{1}{2}}$ = 1.25 sec) have been produced in gas targets by (d,n) reactions and polarized by means of optical pumping or spin exchange scattering with optically pumped ^{87}Rb. An asymmetry up to 3% in the β-decay of the polarized nuclei was found, which served to detect rf transitions between hfs levels of atomic states of ^{21}Na and ^{37}K. $\Delta F = 0$ and $\Delta F = 1$ resonances have been recorded, yielding spin, hfs separation and magnetic moment, especially $I(^{37}K) = ^3/_2$, $\Delta W(^{37}K) = 240.266(3)$ Mc/sec and $\mu_I(^{37}K) = 0.02033(6)$ nm (diamagnetically corrected). For ^{21}Na earlier rf-spectroscopic data have been confirmed. (auth)

49377 COULOMB EXCITATION OF ^{24}Mg WITH ^{35}Cl IONS. Pelte, D.; Hausser, O.; Alexander, T. K.; Evans, H. C. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Phys., 47: 1929-40(Sept. 15, 1969). (AECL-3354).

The Coulomb excitation of a thick ^{24}Mg target was studied with ^{35}Cl ions of 61, 57, and 52 MeV. The absolute cross section and the anisotropy of the angular distribution of the ground state transition from the 1.369-MeV state in ^{24}Mg was measured, and their dependence on B(E2) and the quadrupole moment, Q, of the 1.369-MeV state was calculated. A B(E2) of 24.5 ± 2.2 Weisskopf units (W.u.) was deduced from the line shape of the 1.369-MeV gamma ray observed with a 40 cm^3 Ge(Li) detector. The quadrupole moment determined from the anisotropy measurement was Q = −0.38 ± 0.16 barn. From the cross-section measurement, Q = −0.47 ± 0.19 barn was obtained using B(E2) = 24.5 ± 2.2 W.u. The dependence of this value of Q on B(E2) is discussed. (auth)

49378 J-DEPENDENCE STUDIES IN (α,p) REACTIONS AT 30 MeV. August, L. S.; Shapiro, P.; Cooper, L. R. (Naval Research Lab., Washington, D. C.). Phys. Rev. Lett., 23: 537-40 (Sept. 8, 1969).

Proton angular distributions have been measured for the reactions ^{58}Ni(α,p)^{61}Cu, ^{60}Ni(α,p)^{63}Cu, and ^{28}Si(α,p)^{31}P at E_α = 30 MeV. Strong J dependence is observed for the l = 1 transfer distributions to the ground and first excited states of ^{61}Cu and ^{63}Cu, whereas essentially no J dependence is observed for the l = 2 transfer distributions to the first and second excited states of ^{31}P. Distorted-wave Born-approximation calculations are also discussed. (auth)

Nuclear Properties and Reactions, A ≥ 90

Refer also to abstracts 47448, 47745, 47765, 47797, 47798, 49017, 49315, 49319, 49332, 49355, and 49371.

49379 (AD-686041) FISSION YIELDS OF SEVERAL IODINE ISOTOPES AND HALF-LIFE AND FISSION YIELD OF ^{135}Te. Greendale, Allen E.; Delucchi, Arnaldo A. (Naval Radiological Defense Lab., San Francisco, Calif.). Dec. 31, 1968. 29p. (USNRDL-TR-69-11). CFSTI.

Measurements have been made of the independent fission yields of several iodine isotopes in thermal-neutron-induced fission of ^{235}U. These yields were obtained by isolation of iodine fission products at early times after fission by a new, fast radiochemical procedure. The fractional cumulative fission yield and half-life of ^{135}Te were also determined from the experimental results. (auth) (USGRDR)

49380 (AE-367) GAMMA RADIATION FROM FISSION FRAGMENTS EXPERIMENTAL APPARATUS. MASS SPECTRUM RESOLUTION. Higbie, J. (Aktiebolaget Atomenergi, Studsvik (Sweden)). Aug. 1969. 49p. Dep. CFSTI (U. S. Sales Only).

The gamma-radiation from fission fragments was studied as a function of the fragment mass. The mass was determined from the fragment energies using solid state detectors. The mass resolution which can be achieved by this method is treated in detail. The average initial fragment mass and the initial mass resolution is calculated as a function of the measured (apparent) mass yield for three different thicknesses of the fissile material deposit. This treatment gives a clear indication of those factors most important for good mass resolution work. A detailed description of the experimental apparatus is given in the appendices. (Sweden)

49381 (AERE-M-2157(Rev.)) AVERAGE FISSION CROSS SECTIONS AND RESONANCE INTEGRAL CONTRIBUTIONS BETWEEN 10 eV AND 20 keV DEDUCED FROM SCISRS DATA TAPES. James, G. D.; Schomberg, M. G. (Atomic Energy Research Establishment, Harwell (England)). June 1969. 16p. Dep. CFSTI (U. S. Sales Only). UK 2s. 6d.

Data tapes listing the experimental fission cross section data below 35 keV from the SCISRS data file were obtained and used to determine the average fission cross section and resonance integral contributions over selected energy ranges from 10 eV to 20 keV. These results are presented in tabular form. The causes of the discrepancies noted earlier were investigated. It is suggested that the information in each data set could be used to generate a single number which could be used by each user to confirm that the data set is correct. (auth) (UK)

49382 (AERE-R-6063) THE HALF-LIFE OF ^{198}Au AND THE MEASUREMENT OF HALF-LIVES BY GAMMA-RAY SPECTROMETRY. Cabell, M. J.; Wilkins, M. (Atomic Energy Research Establishment, Harwell (England)). June 1969. 46p. Dep. CFSTI (U. S. Sales Only). UK 7s. 0d.

The half-life of ^{198}Au was measured by observing the rate of decay of the photopeak produced by its 0.412 MeV gamma-ray in a sodium iodide scintillation detector. The crude spectral data were analyzed using five different statistical models. In the first four of these the common method of fitting a straight line to the logarithm of the decay curve was employed. Either the height or the area of the photopeak was chosen as the observed variable, and the squares of the residuals were either unweighted, or weighted proportionally to the reciprocals of the variances of the observed variable, to obtain the best fit. The results from these analyses were found to depend on the period of time during which the decay data were accumulated. Moreover, it is known that the linear transformation may lead to biased results. In the fifth method of analysis the areas of the photopeaks were fitted to an untransformed exponential decay curve, the squares of the residuals being weighted proportionally to the reciprocals of the variances of the areas produced by the fit. It is known that this method yields unbiased results provided the decay data are accumulated over three half-lives or more. Since, however, this method employs iterative procedures, a computer was necessary to achieve the desired accuracy. A listing of the computer program, which can be adapted easily to fit other cases, is given. The mean of two unbiased estimates gave the half-life of ^{198}Au as 2.6946 ± 0.0010 days. 7 references. (auth) (UK)

49383 (ANL-7567) FAST-NEUTRON CROSS SECTIONS OF HAFNIUM, GADOLINIUM, AND SAMARIUM. Sherwood, G. L.; Smith, A. B.; Whalen, J. F. (Argonne National Lab., Ill.). May 1969. Contract W-31-109-eng-38. 71p. Dep. CFSTI.

Elastic and inelastic neutron-scattering cross sections of elemental hafnium, gadolinium, and samarium were measured at incident neutron energies of 0.3 to 1.5 MeV. The experimental resolution was sufficient to reasonably resolve elastic and inelastic processes and to define individual inelastic cross sections for the most appreciably excited states. The total neutron cross sections were determined up to 1.5 MeV with resolutions of ~2.5 keV. Within the precisions of the measurements, all observed cross sections were relatively smooth functions of energy. The experimental results were compared with those obtained from calculations based upon both spherical and deformed optical potentials and statistical theory, inclusive of fluctuation corrections. The calculated results were descriptive of measured total, elastic scattering, and, to a lesser extent, inelastic scattering cross sections. Experimental and calculated results were compared with previously reported measured values and with the contents of several evaluated neutron data sets used in reactor design. (auth)

49384 (BNL-50168) NUCLEAR AND PHYSICAL PROPERTIES OF ^{252}Cf. Prince, A. (Brookhaven National Lab., Upton, N. Y.). Apr. 1969 91p. Dep. CFSTI.

A review of the nuclear and physical properties of ^{252}Cf is presented. Experimental and calculated data on decay properties, α activity, and spontaneous fission include mass distribution, kinetic energy of fission fragments, energy and angular distribution of neutrons, nuclear charge distribution, prompt and delayed neutrons and gamma rays, and tri-partition of k-x-rays. Neutron-induced reactions are also investigated, and experimental and estimated values of the thermal capture and fission cross sections as well as the capture and fission resonance integrals are given, along with the average number of prompt neutrons per neutron-induced fission. The high energy (1 keV to 15 MeV) cross sections for all neutron-induced reactions are calculated using a coupled-channel analysis. 106 references. (auth)

49385 (BNL-50185) THE DOPPLER COEFFICIENT OF ^{238}U NEUTRON RESONANCES AND OF THE PWR FUEL CELL. Purohit, S. N. (Brookhaven National Lab., Upton, N. Y.). July 1969. 35p. Dep. CFSTI.

A study was made of the Doppler coefficient of ^{238}U neutron resonances, in a uranium dioxide fuel rod, by varying the ^{238}U resonance parameters (neutron and radiation widths). This study was undertaken with the ZUT and TUZ codes. From the numerical results obtained, it is concluded that the uncertainty in the present values of ^{238}U resonance parameters (20% in radiation width and a few percent in neutron width) can introduce an uncertainty of the magnitude of 10 to 12% in the Doppler coefficient. In addition, the Doppler coefficient of a power reactor (PWR) fuel cell was studied with the HAMMER code. Extensive numerical results were obtained by varying the fuel enrichment from 0.7 to 3.7%. These results demonstrate that ^{235}U resonances can contribute up to 10% to the Doppler coefficient, for a 3% enriched fuel cell. Finally, this study confirms the temperature dependence of the resonance integral in the form of $\sqrt{T}$ law. (auth)

49386 (BNL-tr-284) GAMMA-RAY SPECTRUM FROM RADIATIVE CAPTURE IN Cs. Becvar, F.; Vrzal, J.; Liptak, J.; Urbanec, J. Translated by Stephen J. Amoretty (Brookhaven National Lab., Upton, N. Y.), from Czech. J. Phys., 19: 248-53(1969). 14p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 23: 15450. (auth)

49387 (CEA-CONF-1322) ANALOGUE STATES OF ^{140}La LEVELS. Temmer, G. M. (Rutgers-The State Univ., New Brunswich, N. J.); Cassagnou, Y.; Foissel, P.; Lamehi-Rachti, M.; Levi, C.; Mittig, W.; Papineau, L. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 1969. 1p. (CONF-690804-15). Dep. CFSTI (U. S. Sales Only).

From International Conference on Properties of Nuclear States, Montreal, Canada.

The excitation functions of proton elastic and inelastic scattering by ^{139}La at 9 to 12.1 MeV were measured. Resonances to the 166-keV level and four levels above 1 MeV in ^{139}La were observed in the inelastic scattering. There is clear evidence that a resonance at 10.27 MeV is the analog of the 1$^-$ 466-keV state in ^{140}La. (J.W.R.)

49388 (CEA-CONF-1323) INELASTIC ELECTRON SCATTERING FROM ^{90}Zr. Bockelman, C. K.; Curtiss, T. H.; Eisenstein, R. A.; Madsen, D. W. (Yale Univ., New Haven, Conn. Electron Accelerator Lab.); Bellicard, J. B.; Leconte, P. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). [1969]. 1p. (CONF-690804-4). Dep. CFSTI (U. S. Sales Only).

From International Conference on Properties of Nuclear States, Montreal, Canada.

The collective states of zirconium-90 were studied with the 70-MeV electron linac at Yale University. At low energies such measurements determine by a unique way the reduced transition probabilities. For ^{90}Zr these B(EL) values compare to those given by the R.P.A. description of vibration for even isotones by Gillet et al. (Phys. Lett., 27B: 483(1968)). Measurements were carried out on an enriched target of ^{90}Zr using 58-MeV electrons. The momentum transfer varied from 0.3 to 0.6 f-m. The total energy resolution was 120 keV. The prominent peaks at 2.18, 2.74, and 3.84 MeV are known to be 2$^+$, 3$^-$, and 2$^+$, respectively. A distorted wave calculation was used to analyze the inelastic data. (B.G.D.)

49389 (EIR-157) DISTRIBUTION OF MASS AND CHARGE IN THE FISSION OF ^{227}Th. Flynn, K. F.; von Gunten, H. R. (Eidgenoessisches Institut fuer Reaktorforschung, Wuerenlingen (Switzerland)). June 1969. 18p. (CONF-690708-3). Dep. CFSTI (U. S. Sales Only).

From 2nd Conference on Physics and Chemistry of Fission, Vienna, Austria.

The distribution of mass and charge in the thermal-neutron-induced fission of ^{227}Th was investigated by radiochemical determination of the fission yields of 29 mass chains and one shielded nuclide (independent yield). The yields were determined relative to the known yields for ^{235}U fission and normalized to absolute values by summation to 200% total fission yield. The mass distribution is asymmetric; the heavy-mass group is centered at about the same position (mass 138.5) as in all previously investigated cases of low-energy fission, while the light-mass group is shifted to a lower mass number (89). The peak half width (full width at half maximum) is 11.5 mass units, and the full width at one tenth maximum is 19 mass units. All these values fall well on systematic plots for the positions of the peaks and for the widths of mass distributions for various fissionable nuclides. The relative probability of asymmetric to symmetric fission (peak-to-valley ratio) is about 230. The fission yield data for ^{227}Th indicate a value of about 1 for $\bar{\nu}$, the average number of neutrons emitted per fission. The mass distribution shows no indication of a third peak in the region of symmetric fission. The division of nuclear charge, as indicated by the independent yield of ^{136}Cs, is consistent with the equal charge displacement hypothesis characteristic of low-energy fission. A comparison of mass distributions in thermal-neutron-induced fission, reactor-neutron-induced fission and spontaneous fission for several fissioning nuclei is given. (auth)

49390 (EURFNR-638) TWO-LEVEL RESONANCE FORMULAS AND THEIR APPLICATION OF THE EFFECTIVE RESONANCE INTEGRAL. Menapace, E.; Motta, M. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Translation of report PRV-r-(68)-16. 31p. (RT/FIMA-(68)-2). Dep. CFSTI.

Work performed under United States-Euratom Fast Reactor Exchange Program.

An expression is developed which gives the cross-section curve when two resonances are near, so that allowance must be made for positive and negative interference effects. In general, the use of multi-level formulas is suggested for situations in which the dis-

tance between the resonances is comparable with their width, as occurs with ^{233}U and ^{239}Pu fissile isotopes, for instance. The significant cases considered are those which represent situations of maximum positive or negative interference. The cross sections for such cases are then used to evaluate the effective resonance integral. Finally, a description is given of the Fortran RESON code written for the IBM-7094 digital computer, which uses the formulas found to carry out this type of calculation. The code includes a subroutine (MOLDES) which calculates the two-level cross section, widened by the Doppler effect, as a function of temperature. (auth)

49391 (JINR-P6-4539) INVESTIGATION OF THE PROPERTIES OF THE NEUTRON DEFICIENT CESIUM NUCLEI. PART I. NEW ISOTOPES ^{122}Cs AND ^{124}Cs. Droste, Ch.; Neubert W.; Morek, T.; Chojnacki, S.; Wilhelmi, Z.; Alexander, K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1969. 17p. (In Russian). Dep. CFSTI (U. S. Sales Only).

The β^+ decay of ^{122}Cs and ^{124}Cs was investigated. The isotopes were produced in the reaction $^{113}In(^{12}C,3n)^{122}Cs$, $^{109}Ag(^{12}O,5n)^{122}Cs$ and $^{115}In(^{12}C,3n)^{124}Cs$, respectively. The half-life of ^{122}Cs is (23 ± 6) sec and of ^{124}Cs is (34 ± 6) sec. The spin and parity of the ground state of ^{124}Cs are $I^{\pi} = 1^+$. (auth)

49392 (N-69-30074) EXCITED STATES OF ^{130}Xe POPULATED BY BETA DECAY. Fessler, Theodore E.; Julian, Glenn M.; Jha, S. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). July 1969. 19p. (NASA-TN-D-5329). CFSTI.

Gamma rays emitted in the beta decay of 5^- ^{130}I and 1^+ ^{130}Cs have been studied with Ge(Li) and NaI(Tl) spectrometers. Twenty-four transitions were observed in the decay of ^{130}I, and 16 were observed in the decay of ^{130}Cs. From the gamma-ray singles spectra and from coincidence studies, the following excited levels of ^{130}Xe have been deduced: 536.1 (2^+), 1122.1 (2^+), 1204.5 (4^+), 1785.9, 1793.5, 1800.1, 1808.1, 1943.9 (5^+), 2016.1, 2150.6, 2171.3, 2223.3, 2242.8, 2361.8 (6^+), 2427.0, 2532.3, 2608.6, and 2752.3 keV. No evidence has been found for the population of a possible 0^+ vibrational triplet member at about twice the energy of the first excited state. (auth) (STAR)

49393 (NYO-72-227) PEGRAM NUCLEAR PHYSICS LABORATORIES PROGRESS REPORT, JANUARY 1968-DECEMBER 1968. (Columbia Univ., New York. Dept. of Physics). Contract AT-30-1-GEN-72. 138p. Dep. CFSTI.

FISSION PRODUCTS—mass and energy distributions before and after neutron emission (E)
NEODYMIUM-142—neutron resonance energies in intermediate range (E)
NEODYMIUM-143—neutron resonance energies in intermediate range (E)
NEODYMIUM-144—neutron resonance energies in intermediate range (E)
NEODYMIUM-145—neutron resonance energies in intermediate range (E)
NEODYMIUM-146—neutron resonance energies in intermediate range (E)
NEODYMIUM-150—energy-level transitions from Coulomb excitation (E)
PLUTONIUM-239—neutron fission of, mass and energy distributions of fragments from (E)
PLUTONIUM-240—spontaneous fission of, mass and energy distributions of fragments from (E)
PULSE ANALYZERS—design of time, for neutron time-of-flight spectrometer at Nevis synchrocyclotron
TANTALUM-186—Moessbauer spectra in tungsten selenide and tungsten sulfide (E)
URANIUM-233—neutron resonances in, time-of-flight spectra for epithermal (E) (J.W.R.)

49394 (RLO-1062-691) NUCLEAR PHYSICS GROUP ANNUAL PROGRESS REPORT FOR PERIOD ENDING JULY 31, 1969. (Oregon State Univ., Corvallis. Dept. of Physics). Contract AT-(45-1)-1062. 82p. Dep. CFSTI.

This report summarizes the research effort and technical progress of the Nuclear Physics Group of the Department of Physics of Oregon State University for the one-year period ending July 31, 1969. The work described includes the investigations in the beta-gamma spectroscopy group, theoretical nuclear studies, some nuclear interaction studies, and the status of the cyclotron modification. (auth)

49395 (RLO-1388-99) COMPETITION BETWEEN NEUTRON EMISSION AND FISSION AT MODERATE EXCITATION ENERGIES IN THE URANIUM REGION. Bishop, Charles Joseph (Washington Univ., Seattle). 1969. 104p. Dep. CFSTI. Thesis.

The ratio of the probability of neutron emission to the probability of fission, Γ_n/Γ_f, was studied to determine its dependence on excitation energy of the compound nucleus. The experimental method used involves detecting neutrons in coincidence with fission fragments at 0 and 90° with respect to the fragments. Pre-fission neutrons (related to Γ_n) are isotropic while post-fission neutrons (related to Γ_f) are highly correlated with the fragment direction. ^{233}U and ^{238}U were bombarded with 11.5 to 22-MeV protons and post-fission/pre-fission neutron ratios determined. ^{252}Cf, a spontaneous fissioning nuclide, was also studied. Experimental results for ^{238}U + p indicate that Γ_n/Γ_f decreases an average of 1.25 to 1.50 per excitation energy step increase of ~6.5 MeV. Reevaluation of Γ_n/Γ_f values from other sources support this conclusion. The large fissionability of ^{233}U results in very few pre-fission neutrons and large statistical uncertainties in the answers which prevents a unique prediction of the energy dependence of Γ_n/Γ_f. Using conventional statistical model calculations with a Fermi gas level density expression, the results can be accounted for by assuming $a_f/a_n \sim 1.1$ and $a_f = A/9$. An alternative explanation involving the dimensionality (degrees of freedom) needed to adequately describe the fission process is briefly discussed with the conclusion that many additional degrees of freedom would be necessary to explain the experimental results. Within the limits of the experiment it is concluded that $\nu_{scission}$, the number of scission neutrons per fission, is 0.3 for ^{252}Cf and <0.1 for ^{235}U. ^{238}U requires a $\nu_{scission}$ of ~0.2 to explain the experimental results. By analyzing the experimental data in a different manner it is possible to extract ν, the number of neutrons per fission, as a function of the fragment mass A, and also study the energy dependence of ν. Results indicate that ν as a function of A shows the now familiar sawtooth curve structure. An increase in excitation energy results in a washing out of the structure of the curve with most of the additional neutrons coming from the heavier fragment. (auth)

49396 (UJV-2228-R) FLUCTUATION OF PARTIAL RADIATION WIDTHS FROM RESONANCE NEUTRON CAPTURE IN THE ^{141}Pr NUCLEUS. Becvar, F.; Telezhnikov, S. A.; Pospisil, J.; Urbanec, J.; Vrzal, J. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). July 1969. 10p. Dep. CFSTI (U. S. Sales Only).

A statistical analysis of the fluctuations of the partial radiative widths from resonance neutron capture in ^{141}Pr was performed. The partial widths were reduced to the energy dependence in E^3 and to the relative level density spin dependence. The number of degrees of freedom in the Porter-Thomas distribution was made for a statistical sample from experimental data by the maximum likelihood method. The large number of degrees of freedom obtained for 3^+ resonances suggests that pronounced nuclear structure effects appear in ^{142}Pr and that the statistical model is not fully adequate in this case. (J.W.R.)

49397 (UUIP-629) INTERNAL CONVERSION STUDIES OF DOUBLE DECAY PROCESSES IN ^{114}In. Vukanovic, R.; Samuelsson, L.; Migahed, M.; Westerberg, L.; Edvardson, L. O. (Uppsala Univ. (Sweden). Inst. of Physics). Mar. 1969. 5p. Dep.

Coincident events, which satisfy the energy conditions for double internal conversion, were observed for the 192-keV transition ^{114}In by extrapolating to a zero mass source, it was found that $T_{KK}/T_K = 1.7(3) \times 10^{-5}$. (Sweden)

49398 (WASH-1127) REPORTS TO THE AEC NUCLEAR CROSS SECTIONS ADVISORY COMMITTEE. Meeting Held at Oak Ridge National Laboratory, Oak Ridge, Tennessee, April 15-17, 1969. Moore, M. S. (comp.) (Nuclear Cross Sections Advisory Committee (AEC)). 276p. (EANDC(US)-120-U; INDC(US)-10-U). Dep. CFSTI.

Eighteen reports submitted to the AEC Nuclear Cross Sections Advisory Committee are presented. The work covered microscopic neutron cross sections, charged particle cross sections, and gamma-ray production by nuclear reactions or radioactive decay. (J.W.R.)

49399 PERTURBED ANGULAR CORRELATIONS IN ^{166}Ho. Kawase, Yoichi; Hayashi, Takeo (Kyoto Univ.). Annu. Rep. Res. Reactor Inst., Kyoto Univ., 2: 1-6(1969).

The perturbed angular correlation of the 1380-81 keV gamma-gamma cascade in the decay of 26.9 hr ^{166}Ho was measured for several chemical compounds at various temperatures. The ratio of λ_1/λ_2 for liquid sources of $HoCl_3$ and $Ho(NO_3)_3$ suggests that the attenuation is caused by a magnetic dipole interaction. The result for aqueous solution of chelate compounds shows that the interaction is similar to the one for solid state sources. In the case of $HoCl_3 \cdot 6H_2O$ source, the attenuation was found to become stronger as the temperature went down. A qualitative explanation of the above trend is given briefly. (auth)

49400 GAMMA RAYS IN THE DECAY OF ^{105}Cd. Okano, Kotoyuki; Kawase, Yoichi; Uehara, Shinichi; Takeuchi, Takayuki;

Hayashi, Takeo (Kyoto Univ.). Annu. Rep. Res. Reactor Inst., Kyoto Univ., 2: 83-6(1969).

The level structure of ^{105}Ag was studied through the position and electron capture decay of ^{105}Cd. Gamma rays from ^{105}Cd prepared by the (γ,n) reaction on ^{106}Cd were measured with a Ge(Li) detector. Two strong lines of 346.8 and 433.2 keV corresponding to transitions from the core-coupled $^5/_2^-$ and $^9/_2^-$ states to the ground states were noted. (J.W.R.)

49401 QUADRUPOLE AND OCTUPOLE SINGLE-PHONON STATES OF NUCLEI IN THE REGION OF 174 ≤ A ≤ 188. Malov, L. A.; Solov'ev, V. G.; Fainer, U. M. (Joint Inst. of Nuclear Studies, Dubna, USSR). Dokl. Akad. Nauk SSSR, 186: 299-301 (May 11, 1969). (In Russian).

The energies, wave functions, and the reduced probabilities of the electric E2- and E3-transitions for the first two quadrupole states with $K^\pi = 0^+$ and 2^+ and the octupole states with $K^\pi = 0^-$, 1^- and 2^- were calculated on a computer for the even–even nuclei ^{174}Yb, ^{176}Yb, ^{178}Yb, ^{176}Hf, ^{178}Hf, ^{180}Hf, ^{176}W, ^{180}W, ^{182}W, ^{184}W, ^{186}W, ^{182}Os, ^{184}Os, ^{186}Os and ^{188}Os. A Saxon-Woods potential and also a modified Nilsson potential were used with allowance for deformation. Constants for pair interactions, and a decreased density of single-particle states were introduced into the formulas. The calculated values support, or at least do not contradict, the available experimental values in the literature for these nuclei. Calculations of octupole states with $K^\pi = 0^-$, 1^- and 2^- showed that states with $K^\pi = 0^-$ are more strongly collectivized in comparison with states having $K^\pi = 1^-$ and 2^-. These first quadrupole and octupole states are well described by a superfluid model of the nucleus. The calculations based on the wave functions of a Saxon-Woods potential utilize a smaller number of parameters as compared with the calculations based on the Nilsson potential. (TTT)

49402 NEW TRANSURANIC ELEMENTS. Zvara, Ivo (Lab. of Nuclear Reactions, Dubna, USSR). Sci. World, 13: 11-16(1969).

Tracer quantities of Es and Fm were first synthesized as early as in 1952 by the irradiation of U with the immense neutron flux created by the detonation of a thermonuclear device. The new period of studies began with the construction of accelerators for multiply charged atomic ions of elements heavier than He to an energy higher than 5.5 MeV per at. mass unit. The beam intensity of modern heavy ion accelerators reaches 10^{11}–10^{13} particles per sec. The maximum yield of compound nuclei is about 10^7 per sec and roughly 1 atom of an element 102–105 is formed per 10^8 and sometimes even 10^{10} compound nuclei. The laboratories at Dubna and Berkeley lead in the synthesis and study of the heaviest elements. Both accelerators provide heavy ions of approximately equal energy. The intensity of the beam is considerably higher in the cyclotron at Dubna. Seven isotopes of element 102 were obtained in experiments performed in 1963–1966 at Dubna by the bombardment of U with Ne ions, Pu with O ions, and Am with N ions, and in 1967 at Berkeley by the bombardment of Cm with C ions. The first certain evidence of the synthesis of element 103 was obtained in 1965 at Dubna and some basic properties of its isotope, mass number 256 produced by the interaction of ^{16}O ions with ^{243}Am and ^{19}F ions with ^{242}Pu, were studied in 1965–1967. The first isotope of element 104 was synthesized in 1964. In 1968, some preliminary data on element 105 were obtained at Dubna. An α-emitting isotope of the element with a half-life of less than 0.1 sec was observed. A new method designed for studying the properties of elements in the gas phase, which results in a reduction of time necessary for performing an elementary experiment, is described as the technique used to determine chemistry of highly unstable isotopes. At 300° in the presence of $ZrCl_4$ vapors serving as a carrier for the elements of fourth group, the chloride of element 104 passes through a filter behaving in the same manner as Hf while chlorides of elements 102 and 103 are adsorbed quantitatively on the walls of the connecting tube and on the filter. Synthesis of future elements is discussed. The most difficult problem is that of producing very high charge ions because, for example, to accelerate Kr and U directly in the Dubna cyclotron, an ion source providing many Kr^{16+} and U^{48+} ions is required. (BBB)

49403 LEVEL-CROSSING INVESTIGATION OF THE $6p^2P_{\frac{1}{2}}$ AND $7p^2P$ LEVELS OF ^{133}Cs, ^{135}Cs, AND ^{137}Cs. Svanberg, S.; Rydberg, S. (Chalmers Univ. of Tech., Goteborg). Z. Phys., 227: 216-33(1969).

The level-crossing method was used for the investigation of the hyperfine structure of the $6p^2P_{\frac{1}{2}}$ and $7p^2P_{\frac{1}{2}}$ levels of the isotopes ^{133}Cs, ^{135}Cs, and ^{137}Cs. The hyperfine coupling constants a and b and the lifetimes τ were determined. From a comparison with double resonance results the g_J factor of the $7p^2P_{\frac{1}{2}}$ level was deduced: $g_J(7p^2P_{\frac{1}{2}}) = -1.3349(10)$. Level crossing measurements in the $8p^2P_{\frac{1}{2}}$ state of ^{133}Cs give for the g_J factor and the lifetime the following results: $g_J(8p^2P_{\frac{1}{2}}) = -1.3353(14)$, $\tau(8p^2P_{\frac{1}{2}}) = 310(15)$ ns. Using recently calculated relativistic correction factors and applying corrections for core polarization and the Sternheimer effect, the following quadrupole moments were obtained: $Q(^{133}Cs) = -0.0030$ b, $Q(^{135}Cs) = +0.052$ b, and $Q(^{137}Cs) = +0.052$ b. (auth)

49404 COMPARATIVE STUDY OF THE FISSION OF BISMUTH AND URANIUM INDUCED BY HIGH-ENERGY PROTONS (156 MeV). Galin, J. (Laboratoire de Chimie Nucleaire, Orsay, France); Lefort, M.; Peter, J.; Tarrago, X.; Cheifetz, E.; Fraenkel, Z. Nucl. Phys., A134: 513-34(1969). (In French).

In the study of fission reactions induced by 156-MeV protons on ^{209}Bi and ^{238}U, mass distributions and kinetic energy distributions of the initial fragments were obtained, using an experimental correction for the evaporation of neutrons from the fragments. A comparison of the results obtained with Bi and with U has shown that 30 per cent of the fission events in U exhibit on asymmetric mass distribution. For these 30 per cent the kinetic energy characteristics are those of low-energy fission in ^{235}U. The results on Bi were compared with predictions of the liquid drop model (Nix-Swiatecki spheroids) and a fairly good agreement was obtained if a reasonable estimation is used for both the mass distribution and the excitation energy distribution of polonium fissioning nuclei. (auth)

49405 PROMPT γ-RAYS FROM NEUTRON INTERACTION IN ^{235}U AND RESONANCE SPIN ASSIGNMENTS. Weigmann, H.; Winter, J.; Heske, M. (EURATOM, Geel, Belgium). Nucl. Phys., A134: 535-40(1969).

Prompt γ-ray spectra from individual resonances in ^{235}U + n were measured using a Ge(Li) detector and the CBNM linear accelerator as a pulsed neutron source. Whereas the spectra show very little structure at high γ-ray energies, several distinct lines were observed in the range 250 keV < E_γ < 1.5 MeV. By comparison of the spectra from resonances with strongly different capture-to-fission ratios decision is possible between γ-rays associated with capture or fission. Resonance spin assignments are made on the basis of the relative strength of the 642 keV γ-ray de-exciting the 2^- level at 687 keV in ^{236}U. (auth)

49406 POPULATION OF THE SPONTANEOUSLY FISSIONING ISOMER $^{244m f}$Am THROUGH THE (n,γ) REACTION. Boca, I. (Institute for Atomic Physics, Bucharest); Martalogu, N.; Sezon, M.; Vilcov, I.; Vilcov, N.; Flerov, G. N.; Pleve, A. A.; Polikanov, S. M.; Tretyakova, S. P. Nucl. Phys., A134: 541-4(1969).

The excitation function of the 0.6 ms spontaneously fissioning isomer $^{244m f}$Am obtained in the reaction ^{243}Am(n,γ)$^{244m f}$Am was measured in the neutron energy range 0.3 to 4 MeV and compared to the results obtained for the spontaneously fissioning isomer $^{242m f}$Am. (auth)

49407 COULOMB EXCITATION OF ROTATIONAL AND VIBRATIONAL STATES IN ^{167}Er, ^{163}Dy, AND ^{155}Gd. Tveter, A. (Univ. of Oslo. Aerospace Research Labs., Wright-Patterson AFB, Ohio); Herskind, B. Nucl. Phys., A134: 599-619(1969).

Low-lying states in deformed odd-neutron rare-earth nuclei were studied by Coulomb excitation with 36- to 52-MeV ^{16}O ions. The gamma rays from the reaction were observed as single spectra in Ge(Li) detectors. In ^{167}Er, the $K_\theta - 2$ and $K_\theta + 2$ gamma-vibrational bands were observed at 532 and 711 keV with $B(E2)\uparrow = 2.6$ and 2.5 s.p.u., respectively. In ^{163}Dy, the $K_\theta - 2$ gamma-vibrational band was observed at 351 keV with $B(E2)\uparrow = 1.2$ s.p.u. The $^3/_2^-|521|$ Nilsson state was observed at 422 keV with $B(E2)\uparrow = 0.5$ s.p.u. due to its Coriolis coupling to the ground band. In ^{155}Gd, the $K_\theta - 2$ gamma-vibrational band was observed at 556 keV with $B(E2)\uparrow = 1.6$ s.p.u. The excitation of the $^1/_2^-|530|$ Nilsson state at 422 keV with $B(E2)\uparrow = 1.2$ s.p.u. seems to be due to Coriolis coupling to the ground band. In this nucleus, indications were found for a beta-vibrational band at 592 keV and a $K_\theta + 2$ gamma-vibrational band at 1028 keV corresponding to $B(E2)\uparrow \geq 1.3$ and 0.8 s.p.u. (auth)

49408 MEASUREMENT AND ANALYSIS OF THE 4.71 MeV $d_{\frac{5}{2}}$ ANALOGUE RESONANCE IN THE ^{90}Zr(p,p_0)^{90}Zr REACTION. Scott, Hugh L.; Swann, C. P.; Rauch, F. (Franklin Inst., Swarthmore, Pa.). Nucl. Phys., A134: 667-72(1969).

The analog of the ground state of ^{91}Zr was studied via the ^{90}Zr(p,p_0)^{90}Zr reaction. Excitation functions were measured for elastically scattered protons at laboratory angles of 115, 125, 135, and 160° with respect to the beam direction for incident proton energies between 4.61 and 4.83 MeV. It is shown that the compound elastic contribution to the cross section is significant, and must be evaluated in order to determine the resonance parameters. The proton width (Γ_p = 4 keV) for this state implies a neutron spectroscopic factor in agreement with analysis of the ^{90}Zr(d,p)^{91}Zr measurements. (auth)

49409 SEARCH FOR NEW TRANSITIONS IN THE DECAY OF ^{164}Ho. da Silva, A. G. (Instituto de Engenharia Nuclear, Rio de Janeiro); Toepke, R. H.; de Barros, S.; Calzavara, S. Notas Fis., Cent. Brasil. Pesqui. Fis., 14: 227-34(1968).

A search for transitions from the 1^+ ground state of ^{164}Ho to the $2'^+$ gamma-vibrational states of ^{164}Dy and ^{166}Er was undertaken. A transition to the 760-keV $2'^+$ level of ^{164}Dy with log ft = 8.0 was found. For the transition to the 860-keV ^{166}Er $2'^+$ level only a lower limit was found (log ft ≥ 7.6). The results are discussed in terms of the multiple quasi-particle-pair interpretation of the gamma vibrations. (auth)

49410 LIGHT NUCLEIC YIELD AT ^{235}U FISSION INDUCED BY THERMAL NEUTRONS. Vorob'ev, A. A.; Grachev, V. T.; Komar, A. P.; Kondurov, I. A.; Nikitin, A. M.; Sellverstov, D. M. At. Energ. (USSR), 27: 31-6(July 1969). (In Russian).

The yields and energy spectra of H, He, Li and Be isotopes emitted during the thermal neutron induced fission of ^{235}U were measured with a time-of-flight mass spectrometer. The energy spectra of ^{2}H, ^{3}H, ^{6}He, ^{4}He are fitted quite well by the Gaussians. The extrapolated yields of the ^{2}H, ^{3}H, ^{6}He isotopes per 100 α-particles are found to be 0.44 ± 0.04, 6.3 ± 0.2 and 1.4 ± 0.1, consequently. ^{8}He, ^{7}Li, ^{8}Li, ^{9}Li, ^{9}Be, ^{10}Be isotopes were identified and the upper limits for ^{5}He, ^{6}Li and ^{7}Be yields were obtained. (auth)

49411 STRUCTURE OF THE 77 keV STATE OF ^{197}Au. Rama Rao, M. T.; Ramamurty, V. V.; Lakshminarayana, V. (Andhra Univ., Waltair, India). Indian J. Phys., 42: 709-16(Dec. 1968).

The half-life of the 77-keV state in ^{197}Au was measured with a Green and Bell type of time-to-amplitude converter and a 100-channel analyser. An electron-electron coincidence method was employed and the slope method was adopted. The value of the half-life of the 77-keV state was obtained as (1.95 ± 0.06) ns. The M1 and E2 gamma-ray transition probabilities of the 77-keV transition were estimated from the measured half-life and compared with the single particle estimates. An M1 hindrance of (363 ± 22) and an E2 enhancement of (17.5 ± 3.5) are observed in the present case. The models proposed by DeShalit and Kisslinger and Sorensen were tested for their applicability. Assuming the ground state wave-function of Kisslinger and Sorensen and with an empirical choice of the amplitude parameters for the 77-keV state, the estimated values were compared with the experimental data. It was observed that the wavefunction of the 77-keV state should contain sizable contributions of the particle and 3/2 + phonon amplitudes. (auth)

49412 THE LEVELS OF ^{103}Rh POPULATED IN THE DECAY OF ^{103}Ru. Raeside, D. E.; Reidy, J. J.; Wiedenbeck, M. L. (Univ. of Michigan, Ann Arbor). Nucl. Phys., A134: 347-52 (1969).

The gamma-ray spectrum associated with the beta decay of ^{103}Ru was studied with curved-crystal and Ge(Li) spectrometers. The energy measurements obtained from the curved-crystal spectrometer data are of greater precision than previously reported measurements. Two gamma rays known to belong to the decay of ^{103}Ru but not seen directly by previous investigators in gamma-ray singles spectra were observed, and intensities are given. Coincidence spectra were taken using a Ge(Li)–Ge(Li) combination. The data confirm the essential features of previously proposed ^{103}Rh level schemes. (auth)

49413 TEMPERATURE DEPENDENCE OF EPITHERMAL NEUTRON CAPTURE AND FISSION IN ^{235}U DIOXIDE. Schoenig, Frederick Carl Jr. Troy, N. Y., Rensselaer Polytechnic Inst., 1968. 175p.

Thesis.

The temperature dependence of epithermal neutron capture and fission in enriched uranium dioxide rods was measured in a 1/E epithermal spectrum. Experiments performed to 1525°C in the reflector of the Thermal Test Reactor have studied the Doppler effect on ^{235}U O_2 fission, and experiments to 1278°C in the core of the Union Carbide Research Reactor have investigated the Doppler effect on ^{235}U O_2 capture and fissions. The samples were cylindrical pellets, 0.341 inches in diameter, mounted between similar pellets to simulate a rod. This UO_2 rod was irradiated at various temperatures in a cadmium covered furnace which was water-cooled so that the temperature of the furnace exterior was that of its environment. Three dilute gold-in-aluminum alloy wires were placed symmetrically about the furnace exterior for neutron flux normalization. The relative numbers of neutron induced captures and fissions in the ^{235}U O_2 samples were determined separately using mass and gamma ray spectrometric techniques. The number of neutron capture events was determined by mass spectrometrically measuring the ratio of ^{236}U to ^{235}U in irradiated and unirradiated samples. The number of neutron fission events was determined by the gamma ray counting of an appropriate fission product. The measurement of the Doppler effect on fission in ^{235}U O_2 over four temperature intervals to 1525°C in two irradiation facilities determined that the Doppler effect increased the effective fission integral of this rod by 2.8 ± 1.0% over the temperature interval 24 to 1525°C. A Doppler fission effect of 4% over this temperature was calculated. The Doppler effect on ^{235}U O_2 capture has been measured to be 15.5 ± 1.8% over the temperature range 241 to 1278°C, which is about 2.7 times greater than the calculated effect. These results are consistent with previous ^{235}U Doppler reactivity experiments in which the calculated Doppler reactivity effect was two to three times less negative than that measured. The effective fission and capture integrals for the enriched uranium dioxide samples have been measured to be 151 ± 18 barns and 67 ± 8 barns respectively, and are in agreement with the calculated values of 144 barns and 60 barns. (Diss. Abstr.)

49414 POSITIVE-PARITY STATES IN SOME ODD-MASS BISMUTH ISOTOPES. Alpsten, M.; Astner, G. (CERN, Geneva). Nucl. Phys., A134: 407-18(1969).

The electron capture decays of ^{207,205,203,201}Po were investigated. Several excited levels were established in the bismuth daughters. Special attention is paid to a group of positive-parity levels at 1902 ($1/2^+$), 2060 ($3/2^+$) and 2405 ($5/2^+$) in ^{207}Bi; at 1497 ($1/2^+$), 1709 ($3/2^+$) and 1969 keV ($5/2^+$) in ^{205}Bi; at 1098 ($1/2^+$), 1313 ($3/2^+$) and 1488 keV ($5/2^+$) in ^{203}Bi and at 846 keV ($1/2^+$) in ^{205}Bi. It is proposed that these states are due to holes in the Z = 82 proton shell, and some arguments supporting this interpretation are given. (auth)

49415 BETA SPECTRUM OF ^{124}Sb. Nagarajan, T. (Univ. of Madras); Ravindranath, M.; Reddy, K. Venkata. Nucl. Phys., A134: 433-41(1969).

The repeated measurements of Langer et al. and Canty et al. do not agree on the magnitude of D in the modified B_{ij} shape. A recent analysis including circular polarization and the former's value of D yielded the matrix element set compatible with CVC theory, whereas the value of D by Canty et al. yielded matrix elements incompatible with CVC theory. The present work gives D = 7.3 ± 1 in good agreement with Canty et al. The statistical accuracy of the present measurement is good enough to distinguish between the different predictions of matrix element sets. A correlation is shown between D and W_0 and the calibration constant. The discrepancy in the results of Langer et al. can be understood on this basis. The existence of beta groups with end-point energies 1579 and 1656 keV is inferred from the FK analysis. (auth)

49416 STUDY OF THE DECAY SCHEME OF $_{73}^{176}$Ta$_{103}$. Boddendijk, H. G.; Idzenga, S.; Kleimeer, G.; Verheul, H. (Vrije Univ., Amsterdam). Nucl. Phys., A134: 442-56(1969).

The decay of ^{176}Ta was studied with Ge(Li) and Si(Li) detectors. The energies and relative intensities of the gamma rays were determined; $\gamma\gamma$ and $e^-\gamma$ coincidence experiments were performed. For the half-life of ^{176}Ta, the value 8.08 ± 0.07 h was determined. With a coincidence experiment, the intensity of the annihilation radiation was precisely measured. From the result, it follows that ^{176}Ta decays for 0.38 ± 0.04% by β^+ decay. The measured K/K + L + M + ... ratio for the electron capture feeding of the 2.9196 MeV level yields for the total transition energy $3.05^{+0.07}_{-0.08}$ MeV. The results are summarized in the decay scheme of ^{176}Ta. Spin assignments are given where possible. (auth)

49417 THE ^{88}Sr(p,γ)^{89}Y REACTION NEAR THE $d_{\frac{5}{2}}$ GROUND-STATE ANALOGUE. Richard, P.; Gabbard, F.; Porter, A. C.; Hopkins, F. F. (Univ. of Texas, Austin). Phys. Lett., 29B: 649-51(Aug. 18, 1969).

The $d_{\frac{5}{2}}$ ground-state analogue of ^{89}Sr is studied with the ^{88}Sr(p,γ) reaction near 5.06 MeV proton energy with a Ge(Li) detector. Excitation functions for γ-ray decay to the ground state, second excited (1.49 MeV) and third excited (1.73 MeV) states of ^{89}Y are measured. The transitions from the $5/2^+$ analogue state to the $3/2^-$ second excited state and $5/2^-$ third excited state are observed to resonate. The resonance cross-section ratios σ_a/σ_γ for the $5/2^+ \rightarrow 3/2^-$ and $5/2^+ \rightarrow 5/2^-$ γ-ray decay are, respectively, 360 and 560 with Γ_γ ($5/2^+ \rightarrow 3/2^-$) = 7 ± 2 eV and Γ_γ ($5/2^+ \rightarrow 5/2^-$) 4 ± 3 eV. (auth)

49418 STRONG L = 0 AND 2 TRANSITIONS IN (p,t) REACTIONS IN EVEN-MASS Nd ISOTOPES. Yagi, K.; Aoki, Y.; Kawa, J.; Sato, K. (Osaka Univ.). Phys. Lett., 29B: 647-8 (Aug. 18, 1969).

The pairing vibrational states near N = 82 were investigated by means of (p,t) reactions on the even-mass Nd isotopes of A = 142 – 150. Strong L = 0 and 2 transitions to the expected pairing vibrational states were observed for the ^{144}Nd(p,t) reaction. (auth)

49419 GAMMA-RAY INVESTIGATION OF DIFFERENT SILVER ISOTOPE DECAY. Liptak, J. (Charles Univ., Prague); Vrzal, J.; Grigor'ev, E. P.; Katykhin, G. S.; Urbanec, J. Czech. J. Phys., 19: 1127-52(1969).

The investigation of different silver isotope decay gamma-rays from A = 102 to A = 113 was made using two Ge(Li) detectors with resolution 3.7 to 6 keV. The results obtained and data from other papers were analyzed to correct and to complete the decay schemes of these nuclei. The radioactivity having a half-life of 3 min is considered as a new isotope of ^{97}Ag. Three new states were added to the level scheme of ^{102}Ag in agreement with the results of the β-gamma and gamma-gamma coincidences. Two gamma-ray transitions were added to the scheme of excited levels of ^{103}Pd. About 60 transitions were found in the decay of the two known isomers of ^{104}Ag. Most of them are located in the decay scheme of the 19 excited levels of the ^{104}Pd isotope. Positive parity was assigned to all of them. The ^{112}Ag and ^{113}Ag gamma-ray spectra were first obtained with the aid of a Ge(Li) spectrometer. The observed transitions were placed in a decay scheme containing 16 levels in the case of ^{112}Cd and 5 levels in the case of ^{113}Cd. The properties of the the low excited even-even isotope states of Ru, Pd and Cd are discussed and compared. (auth)

49420 ^{155}Gd LEVELS EXCITED IN THE DECAY OF ^{155}Tb. Galan, P. (Joint Inst. for Nuclear Research, Dubna, USSR); Kuznetsov, V. V.; Kuznetsova, M. Ya.; Urbanec, J.; Finger, M.; Khristov, D.; Nielsen, O. B.; Jursik, J. Czech. J. Phys., 19: 1153-77(1969).

Conversion electron spectra, gamma rays, and e-γ and γ-γ coincidences in the decay of ^{155}Tb were investigated. The conversion electron spectra were measured with a toroidal six-gap beta spectrometer and a two-fold double-focusing $\pi\sqrt{2}$ beta spectrometer. The gamma rays were measured by means of Ge(Li) detectors. The e-γ-coincidence spectra were investigated by means of the six-gap beta spectrometer and a NaI(Tl)-gamma spectrometer. The γ-γ coincidences were studied by the method of two-dimensional analysis with the use of two coaxial Ge(Li) detectors. A number of transitions was found in ^{155}Tb decay which were not observed up to now. A more complete scheme of the decay ^{155}Tb $\rightarrow$ ^{155}Gd is proposed. Conclusions were reached on the multipolarity of most transitions and possible spin and parity values were determined for the ^{155}Gd levels. The populations of the excited levels in ^{155}Gd were determined and the lg ft values were calculated. A comparison of the results obtained with the calculations by Solovev et al., based on the superfluid model of the nucleus enables one to assign the structure to the 592.6-keV state as follows: [521]↑ − 0.7%, [521]↑ + Q_1(20) − 99% and to interpret the 559.9-keV level as a mixed state of the type [521]↓ − 42%, [521]↑ + Q_1(22) − 37%, [523]↓ + Q_1(22) − 16%. (auth)

49421 THE MEAN LIFETIME OF THE 203 keV LEVEL IN ^{109}Cd. Ben-Zvi, I.; Blaugrund, A. E.; Dar, Y.; Goldring, G.; Wolfson, Y. (Weizmann Inst. of Science, Rehovoth, Israel). Nucl. Phys., A135: 153-8(1969).

The mean lifetime of the $^7/_2^+$, 203 keV level in ^{109}Cd was measured using a recently developed multi-channel version of the microwave method. The level was excited by means of the ^{109}Ag (p,n)^{109}Cd reaction. A mean life $\tau(^{109}\text{Cd}, 203\text{ keV}) = 52^{+4}_{-3}$ ps was measured. The multipolarity of the 260 keV transition was determined to be M2. (auth)

49422 FINITE DISTRIBUTION OF NUCLEAR M1 AND E2 MOMENTS IN MUONIC ^{115}In, ^{133}Cs, AND ^{141}Pr. Lee, W. Y. (Columbia Univ., New York); Bernow, S.; Chen, M. Y.; Cheng, S. C.; Hitlin, D.; Kast, J. W.; Macagno, E. R.; Rushton, A. M.; Wu, C. S.; Budick, B. Phys. Rev. Lett., 23: 648-52(Sept. 22, 1969).

The distributions of nuclear M1 and E2 moments in the nuclei ^{115}In, ^{133}Cs, and ^{141}Pr have been investigated by observing the hfs of their muonic x-ray spectra. The M1 hfs interaction constants are in good agreement with the values calculated from configuration-mixing model. The measured E2 hfs constant in the $2p_{\frac{3}{2}}$ state of muonic ^{115}In is in agreement with theory only if the free-atom value for the spectroscopic quadrupole moment is corrected for atomic polarization effects. (auth)

49423 SYSTEMATICS OF K-ISOMERISM. Rajput, M. S.; Sehgal, M. I. (Aligarh Muslim Univ., India). Indian J. Phys., 42: 537-43(Sept. 1968).

Experimental data on the hindrance factor of the K-forbidden transitions were compiled. From the systematic study of K-forbidden transition in the mass region $160 \leq A \leq 190$, and $A > 230$, it was found that log of hindrance factor per degree forbiddenness of the transition decreases with the increase in the value of degree of forbiddenness of the transition. (auth)

49424 LEVELS AND TRANSITIONS IN ^{208}Bi. Hagee, G. R.; Lange, R. C.; Campbell, A. R. (Mound Lab., Miamisburg, Ohio). Contract AT-33-1-GEN-53. Nucl. Phys., A135: 225-30(1969).

Precise measurements (±0.5 keV) of the transitions in ^{208}Bi following electron-capture decay of ^{208}Po have been made using Ge(Li) and Si(Li) spectroscopy. Gamma-rays observed, and their relative intensities, are 31.7, 63.5, 291.9(100), 539.1(21), 570.7 (58), 602.9(45) and 861.9(31) keV. These fit levels in ^{208}Bi at 63.5, 602.8, 634.4 and 925.6 keV, observed in previous work but now assigned to ±0.8 keV. (auth)

49425 Ω-FORBIDDEN E1 TRANSITIONS IN ^{182}Re. Andrejtscheff, W.; Funke, L.; Meiling, W.; Stary, F. (Bereich Kernphysik, Rossendorf, Ger.). Nucl. Phys., A135: 170-6(1969).

Single γ-ray spectra, $\gamma\gamma$-coincidences and delayed coincidences were measured with Ge(Li) and scintillation detectors. Taking into account the known conversion electron data a decay scheme was established. The half-life of the $^9/_2^+[402]_p$; $^9/_2^-[510]_n$ state at 235.7 keV is 600 ± 30 ns, the half-life of the $^9/_2^+[402]_p$; $^9/_2^-[512]_n$ state at 263.3 keV is 5.1 ± 0.2 ns. The E1 gamma transitions from both levels are forbidden by the omega selection rule and, therefore, extraordinarily retarded. (auth)

49426 RECALCULATION OF THE SCATTERING OF ELECTRONS FROM PARTIALLY ALIGNED NON-SPHERICAL NUCLEI. Wright, L. E. (Inst. for Theoretical Physics, Frankfurt am Main). Nucl. Phys., A135: 139-44(1969).

A distorted wave calculation is performed for elastic and inelastic electron scattering from partially aligned holmium nuclei. The results are compared to the presently known experimental data and the size and sign of the intrinsic quadrupole moment is obtained. (auth)

49427 ANOMALOUS $^5/_2^+$ AND $^7/_2^+$ STATES IN ^{99}Rh FROM THE DECAY OF 21 MIN ^{99}Pd. Phelps, M. E.; Sarantites, D. G. (Washington Univ., St. Louis). Nucl. Phys., A135: 116-38(1969).

Levels in ^{99}Rh populated in the decay of 21 min ^{99}Pd were investigated. From singles γ-ray energy and intensity measurements employing high-resolution and efficiency Ge(Li) detectors, from coincidence relationships established from γ-γ coincidence experiments employing two Ge(Li) detectors and from β^+-γ coincidence experiments employing a plastic scintillator and a Ge(Li) detector, it was found that levels at 64.6, 200.6, 427.3, 464.3, 851.1, 874.4, 1018.3, 1111.2, 1167.4, 1366.5, 1527.4, 1535.9, 1761.2, 1814.8, 1969.2, 2040.3, 2051.9, 2070.6, 2143.7, 2181.3, 2199.2, 2268.0, 2343.3, 2388.8, 2709.3, 2737.4, 2758.9, and 2835.4 keV are populated in the decay of 22 min ^{99}Pd. Possible levels at 2618.1, 2639.4, 2860.3, 2957.4, and 3047.0 keV are suggested on the basis of energy sums. The fraction of decay of ^{99}Pd to the 16 d ^{99}Rh ground state was determined in milking experiments to be 0.02 ± 0.01 and from the proposed decay scheme, which gives 0.029 ± 0.002. From singles positron spectra and from β^+-γ coincidence measurements, the Q_{EC} value for ^{99}Pd decay was determined to be 3405 ± 20 keV. The half-life of ^{99}Pd was measured to be 21.4 ± 0.2 min. From log ft values obtained and from γ-ray branching information, limits for the J^π values of many levels in ^{99}Rh were placed. The level structure of the "anomalous" $^5/_2^+$ and $^7/_2^+$ states in ^{99}Rh is compared with similar levels in other odd-mass Rh isotopes and with recent calculations on the pairing plus-quadrupole model. (auth)

49428 LEVELS IN DOUBLY EVEN TELLURIUM ISOTOPES ^{114,116,118}Te POPULATED IN (α,2n) REACTIONS. Luukko, A.; Kerek, A.; Rezanka, I.; Herrlander, C. J. (Research Inst. for Physics, Stockholm). Nucl. Phys., A135: 49-56(1969).

Levels of doubly even Te isotopes (A = 114 − 118) have been studied in Sn(α,2n) reactions. From intensity and angular distribution measurements members of the ground state vibrational bands have been assigned up to 8^+. No isomeric states in the nanosecond region have been found. (auth)

49429 A LOW-LYING 2^- STATE IN ^{236}U. Lederer, C. M.; Jaklevic, J. M.; Prussin, S. G. (Univ. of California, Berkeley). Nucl. Phys., A135: 36-48(1969).

A low-lying $K^\pi = 2^-$ state of ^{236}U, first characterized in measurements of ^{240}Pu alpha decay, has been more thoroughly studied through the electron-capture decay of ^{236}Np. The energy of the state is 687.70 ± 0.10 keV, its half-life is 4.4 ± 0.6 nsec, and it decays by M2 and E1 transitions to members of the ground state band. It is populated with an intensity of 1.5 ± 0.3% in the decay of ^{236}Np, and (2.1 ± 0.4) × 10^{-5}% in the decay of ^{240}Pu, in the latter case presumably via an alpha transition to the unobserved spin-3 member of the band. Besides having the lowest energy of any known 2^- state in an even nucleus, the state is characterized by fast M2 transitions and highly hindered E1 transitions. (auth)

49430 THE GIANT DIPOLE RESONANCE AND ISOSPIN IN ^{89}Y(p,γ_0)^{90}Zr. Mason, W. M.; Kernel, G.; Black, J. L.; Tanner, N. W. (Nuclear Physics Lab., Oxford). Nucl. Phys., A135: 193-206(1969).

The 90° cross section for the reaction ^{89}Y(p,γ_0)^{90}Zr has been measured for proton energies between 2.6 and 19.0 MeV using

Van de Graaff protons and a NaI counter. Some angular distributions were also measured. There is no evidence of a well-defined component of the dipole resonance with $T \simeq T_3 + 1 = 6$. At low energies, the excitation function is in agreement with a statistical calculation of the Hauser–Feshbach type. At higher energies, there is a direct component showing strong electric quadrupole interference. (auth)

49431 ON DECAY OF ^{242}Am. Aleksandrov, B. M.; Bak, M. A.; Berdikov, V. V.; Ivanov, R. B.; Krivokhatskii, A. S.; Nedovesov, V. G.; Petrzhak, K. A.; Petrov, Yu. G.; Romanov, Yu. F.; Shlyamin, E. A. At. Energ. (USSR), 27: 41-6(July 1969). (In Russian).

Four independent methods were used to measure the half-life of the ground state ^{242}Am: decrease of fission events in the target, increase of the α-activity of the target, decrease of β-activity and number of electron captures in the target. The half-life of ^{242}Am is found to be (16.07 ± 0.04) hr. The ratio of electron capture probability to total decay probability of ^{242}Am is found to be 0.18 ± 0.01. The estimation of the α-decay probability from ground-state ^{242}Am shows that it does not exceed 10^{-7} from the total number of ^{242}Am decays from the ground state. (auth)

49432 SOME γ-SPECTROSCOPIC STUDIES OF NUCLEI IN THE REGION OF THE MAGIC NEUTRON NUMBER N = 82: ^{141}Pr, ^{143}Pm, ^{139}Pr, AND ^{141}Pm. Hesse, Klaus (Technische Hochschule, Darmstadt, Ger.). Z. Phys., 226: 328-63(1969). (In German).

The level schemes of the nuclei ^{141}Pr, ^{143}Pm, ^{139}Pr, and ^{141}Pm were investigated by measuring the γ-spectra following the β-decay of the corresponding (Z + 1)-isobars. The existing level schemes for these nuclides were thereby enlarged or revised. The results are discussed using the weak-coupling picture. (auth)

49433 DETERMINATION OF THE K-CONVERSION COEFFICIENT OF THE $2^+ \rightarrow 0^+$ TRANSITIONS IN ^{170}Yb AND ^{166}Er. Falkstroem, E.; Nilsson, S.; Boreving, S. (Chalmers Univ. of Tech., Goteborg). Ark. Fys., 39: 1-6(1969).

The K-conversion coefficients were determined by crystal diffraction to be 1.32 ± 0.04 for the 84.2-keV transition in ^{170}Yb and 1.63 ± 0.05 for the 80.5-keV transition in ^{166}Er. (auth) (Sweden)

49434 A DIRECTIONAL CORRELATION STUDY OF INTERBAND TRANSITIONS IN ^{172}Yb. Vukanovic, R.; Zupancic, M.; Lindstroem, H. A.; Samuelsson, L. (Univ. of Uppsala). Ark. Fys., 39: 113-31(1969).

The $\Delta K = 3$ transitions de-exciting the K = 3 rotational band based on the 1172-keV state were studied by γ-e and e-e directional correlations. The mixing ratios Δ(E2/M1) for the transitions 912 keV $\Delta = +1.7(2)$, 1003 keV Δ abs. > 13, 1093 keV $\Delta = +3.3(4)$, and 115 keV abs. >3.3, were determined and compared with theoretical predictions. The conversion coefficient of the 912-keV transition was obtained as well as the total K particle parameters for the 912-keV and 1093-keV transitions. The half-life of the 1172-keV state was found to be $T_{\frac{1}{2}} = 7.9(5)$ ns. (auth) (Sweden)

49435 TWO-PARTICLE LEVELS WITH $I^\pi = 7^-$ AND 5^- IN EVEN-EVEN ISOTOPES OF ^{52}Te AND ^{78}Pt. Dzhelepov, B. S.; Peker, L. K.; Vorob'ev, V. D. Izv. Akad. Nauk SSSR, Ser. Fiz., 33: 562-5(Apr. 1969). (In Russian).

Quasiparticle (two particle, etc.) states are of interest for the understanding of the nuclear structure, in particular levels with $I^\pi = 7^-$ and 5^- spins and parities because they represent especially "clean" states. It was shown that such levels exist in the ^{126,128,130}Te isotopes and in the ^{188,194,196}Pt nuclei. The β decay of the isomeric states of $^{126,128,(130)}$Sb with a large spin results in the excitation of states with a high spin in the even-even daughter products. On this basis the experimental data of the β decay of the Sb isomers were analyzed again, using decay schemes which included two-particle neutron levels with $I^\pi = 5^-$ in ^{126,128}Te and $I^\pi = 7^-$ in ^{126,128,130}Te nuclei. Similar two-particle proton levels were observed in even ^{192,194,196,198}Hg isotopes and similarly $I^\pi = 7^-$ and 5^- levels could be expected to exist also in the even Pt isotopes. The decay scheme of ^{190*}Ir was developed on the basis of earlier study; it was found that it was similar to the scheme of ^{194*}Ir, making it possible to predict the spins of the new ^{188}Pt levels. There were indications that it involved quasiparticle proton states with $I^\pi = 5^-$; 7^-; 9^-; 10^+. The $I^\pi = 9^-$ level is probably a four-particle level. (TTT)

49436 GAMMA-RAYS IN THE 1 MeV REGION FROM THE REACTION ^{161}Dy(n,γ)^{162}Dy. Baecklin, A.; Boleu, R.; Fogelberg, B. (Univ. of Uppsala). Ark. Fys., 39: 221-9(1969).

The gamma-ray spectrum from the reaction ^{161}Dy(n,γ)^{162}Dy was studied in the 1 MeV region using a Ge(Li) detector. In addition to levels investigated earlier, evidence was found for the population of levels at 1485.74 ± 0.05 and 1518.9 ± 0.3 keV, which are assigned as levels with $K1^\pi = 5^-$ and 0^-, respectively. (Sweden)

Nuclear Theory

Refer also to abstracts 47886, 49026, 49172, 49182, 49301, 49340, 49355, 49363, 49394, and 49401.

49437 (AECL–3366) EFFECTIVE OPERATORS IN THE NUCLEAR SHELL MODEL. A Summary of Talks Given at the Chalk River Nuclear Laboratories and The Oak Ridge National Laboratories, January and April 1969. Harvey, M. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). June 1969. 29p. Dep. CFSTI (U. S. Sales Only). CAN $1.00.

The general formalism of effective operators is discussed with some simple examples. Results are presented of recent calculations on the phenomenological and realistic approach to effective charges of electric multipole operators. (auth)

49438 (BNL–13921) ENVIRONMENTAL EFFECTS ON INTERNAL CONVERSION RATES. Perlman, M. L. (Brookhaven National Lab., Upton, N. Y.); Emery, G. T. (Brookhaven National Lab., Upton, N. Y. Indiana Univ., Bloomington). [1968]. 11p. (CONF-690818–3). Dep. CFSTI.

From International Conference on Radioactivity in Nuclear Spectroscopy, Nashville, Tenn.

There are now a number of cases in which it has been shown that the lifetimes of nuclear isomers, which decay largely by internal conversion, are to some extent dependent on the electronic environment of the radioactive atoms. Changes in lifetimes are stated to have been produced by change in chemical form, by pressure and temperature change, and by superconducting-normal transitions. These effects are generally small because the electrons most involved in chemical bonding or in other electronic changes are almost always minor contributors to the total conversion probability. However, comparatively large effects have been observed for transitions in the decay of ^{119m}Sn and ^{169}Tm, in which instances the intensities of individual conversion lines arising from the outermost electron levels were resolved. For dipole transitions, s electrons make the major contributions to the conversion probability; thus outer shell conversion line intensities, and lifetimes as well, are functions of s electron densities near the nucleus and are directly related to the Moessbauer chemical isomer shifts observable in the non-converted gamma radiations of the same transitions. Combination of the isomer shift and conversion line data yields quantitative information on nuclear charge radius change in the Moessbauer transition. In transitions of higher multipole order, the relationships connecting conversion line intensity, lifetime, and isomer shift are more complex, since the conversion usually involves more than one electron subshell and the variable contributions of the subshells are unresolved in the valence level lines. It is possible in principle to obtain such subshell data from proper combinations of valence shell conversion line intensities. (auth)

49439 (BNL-tr–275) EFFECT OF FLUCTUATIONS OF THE PARTIAL WIDTHS ON THE COMPETITION BETWEEN FISSION AND INELASTIC SCATTERING. Rabotnov, N. S. Translated by Stephen J. Amoretty (Brookhaven National Lab., Upton, N. Y.), from Yadern. Fiz., 9: 775-8(Apr. 1969). 10p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 23: 37315.

49440 (BNL-tr–285) PROBABILITIES OF Eλ TRANSITIONS AND ALLOWED β DECAY IN ODD-MASS DEFORMED NUCLEI. Gareev, F. A.; Ivanova, S. P.; Chernei, M. I. (Joint Inst. for Nuclear Research, Dubna (USSR)). Translated by Stephen J. Amoretty (Brookhaven National Lab., Upton, N. Y.), from report JINR–P4-3935. 11p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 22: 42100. (auth)

49441 (BNL-tr–289) CORRELATION FUNCTIONS FOR NUCLEAR MATTER. Filippov, G. F.; Steshenko, A. I. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). Translated by Stephen J. Amoretty (Brookhaven National Lab., Upton, N. Y.), from report ITF–69-18. 12p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 23: 32951. (auth)

49442 (IAE–1635) IS IT POSSIBLE TO DESCRIBE THE LOWER STATES OF EVEN NUCLEI JUST BY THE COLLECTIVE LEVELS OF FREEDOM? Grechukhin, D. P. (Akademiya Nauk SSSR, Moscow. Institut Atomnoi Energii). 1968. 71p. (In Russian). Dep. CFSTI (U. S. Sales Only).

The ratio of the intensities of the M1 and E2 components of mixed (M1 + E2) transitions of even nuclei in the case of collective phenomenological models is practically independent of the concrete structure of the model, but is determined by how completely the collective (boson) variables are separated from the totality of the nucleonic coordinates. That is, the ratio of the intensities of the

M1 and E2 components can serve as a criterion of the applicability of phenomenological description of the collective excitations of the nuclei, in which it is assumed that the state of a nucleus can be determined as the state of a Hamiltonian not containing any other degrees of freedom than the quadrupolar collective (boson). In accordance with that statement an analysis was made of practically all experimental data known on 1 January 1968 for mixtures of M1 and E2 components in transitions of even nuclei in the range $16 \leq A \leq 254$. A table of data is presented. Comparison of those data with the results flowing from a phenomenological description of the collective excitations of the nuclei shows that in the range $A < 50$ the application of phenomenological collective models makes no sense, in the region $50 < A < 150$ the applicability of phenomenological models is extremely doubtful, and only in the range $150 < A < 190$ are there grounds for the use of phenomenological models of the collective motion. These conclusions should be considered preliminary, however. (auth)

49443 (INR–970) (n,α) REACTIONS AND SOME PROBLEMS CONNECTED WITH THE DIRECT INTERACTIONS IN LOW-ENERGY REGION. Turkiewicz, Jan (Institute of Nuclear Research, Warsaw (Poland)). 1968. 135p. (In Polish). Dep. CFSTI (U. S. Sales Only).

Some results obtained in the experimental investigation of several nuclear reactions of the type (n,α) and (d,p) at low bombarding energies are presented. The purpose of the investigation was to obtain some insight in the mechanism of the reactions studied and to get source informations concerning the structure of nuclei under investigation. Nuclear reactions (n,α) were particularly used as a tool for investigation of the cluster structure of the surface of heavy nuclei. (auth)

49444 (INR–1039) DEPENDENCE OF THE ENERGY OF A NUCLEUS ON THE DEFORMATION. Sobiczewski, A. (Institute of Nuclear Research, Warsaw (Poland)). 1968. 57p. (In Polish). Dep. CFSTI (U. S. Sales Only).

Results of investigations on the deformation dependence of the energy of nuclei, both in the ground and excited states, are discussed. Few regions of deformed nuclei are taken into account. Both stable and far off the stability line nuclei are considered. The problem of long-lived superheavy nuclei is discussed. (auth)

49445 (ITEF–655) STABILIZING EFFECTS OF SHELLS IN POSITIONS OF EXCITED LEVELS OF NUCLEI AND PARAMETERS OF THE STRUCTURE OF THE NEUTRON FORCE FUNCTION. Sukhoruchkin, S. I. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki). 1969. 30p. (In Russian). Dep. CFSTI (U. S. Sales Only).

Analysis of the experimental data on the excited-level positions of a broad range of nuclei confirms the stabilizing effect (found earlier) with the range of several tens of keV. The pairing effect in the single-particle level positions has a range about 1 MeV. Groupings in the values of the neutron separation energies and the neutron level positions of light nuclei can be expressed by the superposition of these two intervals (30 keV and ϵ_{oc} ~1.02 MeV). To obtain reliable values of strength functions when averaging the neutron widths of individual resonances it is necessary to fulfill the condition that the averaging interval exceed the characteristic energy period (30 keV). (auth)

49446 (JINR–P4–4533) NONADIABATIC ROTATIONAL MODEL FOR TWO STRONGLY-COUPLED BANDS IN ODD-MASS NUCLEI. Pyatov, N. I.; Chernei, M. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1969. 23p. (In Russian). Dep. CFSTI (U. S. Sales Only).

The nonadiabatic rotational model proposed by Kerman has been extended to take into account the pairing force and the effect of the Coriolis coupling on the energy gap and chemical potential. Utilizing the variational method equations for energy gap Δ(I), chemical potential λ(I) and rotational energy are derived which include the blocking effect as well. The coupling between quasi-particles and pairing vibrations of the core has been treated with the RPA method. The effects of this coupling are included in the equations for Δ(I) and λ(I). (auth)

49447 (ORNL-TM-2703) FORM FACTORS FOR INELASTIC SCATTERING: THE CODE ATHENA IV. Chwieroth, F. S.; Dodson, J. I.; Johnson, M. B.; Owen, L. W.; Satchler, G. R. (Oak Ridge National Lab., Tenn.). Sept. 5, 1969. 21p. Dep. CFSTI.

A FORTRAN IV code has been written for the IBM-360/75 and 360/91. The code, which is a revised and updated version of the original ATHENA code by M. B. Johnson and L. W. Owen (ORNL-TM-964, 1964), computes form factors for inelastic scattering calculations, using single-particle wave functions that are eigenstates of motion in either a Woods–Saxon potential well or a harmonic oscillator well. Two-body forces of Gauss, Coulomb, Yukawa, and a sum of cut-off Yukawa radial dependences are available; the last may be used, for example, to reproduce the long-range part of the Hamada–Johnston potential. A sum of up to 100 wave function components and up to 10 interaction components may be used. The reduced matrix elements of the one-body multipole operators may be included automatically in the wave function coefficients. Nonlocal effects on the wave functions may be included in the local energy approximation. (auth)

49448 (ORNL-tr-2203) SEMIEMPIRICAL FORMULAS FOR DOUBLE DIFFERENTIAL CROSS SECTIONS OF SECONDARY NUCLEON PRODUCTION IN BOMBARDMENT OF NUCLEI BY NUCLEONS WITH AN ENERGY OF SEVERAL HUNDRED MeV. Sychev, B. S. (Joint Inst. for Nuclear Research, Dubna (USSR)). Translated for Oak Ridge National Lab., Tenn., from report JINR–P2-4306. 16p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 23: 23751.

49449 (UCRL–17541) CALCULATIONS OF THE FLATTENING OF IDEALIZED NUCLEI DURING HEAD-ON COLLISIONS. Maly, Jaromir; Nix, James Rayford (California Univ., Berkeley. Lawrence Radiation Lab.). June 23, 1967. 1p. (CONF-670910-7). Dep. CFSTI.

From International Conference on Nuclear Structure, Tokyo, Japan.

When two nuclei closely approach each other they tend to flatten as a result of their mutual electrostatic forces. The amount they flatten depends upon the relative magnitudes of the electrostatic interaction (which is a function of their charges and separation) and of three of their fundamental nuclear properties: (1) stiffnesses against deformations, (2) inertias with respect to deformations, and (3) viscosities. If the electrostatic interaction is large enough, and each of these three properties is sufficiently small the nuclei will flatten appreciably; otherwise, they will remain essentially spherical. Since the liquid-drop model represents the average trends of nuclear masses in the periodic table, liquid-drop stiffnesses are expected to also represent an average, and a calculation of the flattening of colliding nuclei on the basis of the liquid-drop model should give the average flattening of nuclei throughout the periodic table. The flattening that would be experienced by nonviscous idealized liquid drops in head-on collisions was studied. This is done by integrating numerically the classical equations of motion describing the approach of two incompressible uniformly charged drops that are allowed to deform into spheroids and that are characterized by nonviscous irrotational hydrodynamical flow. (B.G.D.)

49450 DETERMINATION OF NUCLEON–NUCLEON POTENTIALS FROM SCATTERING DATA USING THE MARCHENKO THEORY. Benn, J.; Scharf, G. (Univ., Zurich). Nucl. Phys., A134: 481-504(1969).

Nucleon–nucleon potentials were calculated from scattering phase shifts using the solution of the inverse problem of scattering theory due to Marchenko. This method works without special model assumptions or any given analytic expression of the potential. Furthermore, it is possible to reproduce the data completely. Only T = 1 uncoupled states are considered in this paper. It is found that the potentials should be expressed in the classical form of Wigner without a quadratic LS-term, the L = 0 states being treated entirely phenomenologically by a separate potential. At distances $r < 6$ fm the deviation from the pure Coulomb force due to one-pion exchange becomes significant and for $r < 3$ fm strong deviations from one-pion exchange are found. More detailed information about NN interactions may be obtained when the coupled states are treated as well. (auth)

49451 ATOMIC ELECTRON EJECTION DURING NUCLEAR BETA DECAY. Crasemann, Bernd (Univ. of California, Berkeley. Univ. of California, Livermore); Stephas, Paul. Nucl. Phys., A134: 641-54(1969).

Theoretical approaches to the chief mechanisms of internal ionization during nuclear beta decay are outlined, with particular attention to 1s orbital-electron ejection. Predictions of electron spectra and total ionization probabilities are derived. Available data are briefly reviewed and further work is suggested. (auth)

49452 MEASUREMENT OF LIFETIMES BY MEANS OF UHF FIELDS. Gerber, J.; Vivien, J. P.; Macher, A.; Armbruster, R. (Institut de Recherches Nucleaires, Strasbourg). Rev. Phys. Appl., 4: 218-20(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

Two methods of measuring lifetimes using uhf electric fields are presented. A simulation method gives directly the shape of the decay spectrum. (auth)

49453 CORRELATION MEASUREMENTS OF LIFETIMES OF METASTABLE LEVELS. Favret, D.; Chery, R. (Institut de Phys-

ique Nucleaire, Lyon). Rev. Phys. Appl., 4: 121-2(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

The correlation function measurement of a random function associated with a Poisson relation process allows one to estimate in a more accurate and faster way the half-life times of metastable levels. A 16 channel correlator is used. (auth)

49454 CONSTRUCTION OF COMPLEX NUCLEAR SCHEMES BY COMPUTER. Escudie, B.; Gerson, A.; Charvet, A.; Chery, R. (Institut de Physique Nucleaire, Lyon). Rev. Phys. Appl., 4: 123-4(June 1969). (In French).

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France. See CONF-681208-(Suppl.).

Using Ritz's principle in a numerical manner produces easy information processing in the study of nuclear β-γ decay schemes. Three convenient programs adapted for this analysis are used. (auth)

49455 MODELS OF NUCLEAR-CHARGE DISTRIBUTION. Kaushal, R. S. (Indian Inst. of Tech., Kanpur). Nuovo Cim., Lett., 2: 236-8(Aug. 21, 1969).

The relationship between the Fermi charge distribution, for electron scattering on medium and heavy nuclei, and the oscillator distribution, for light nuclei, is investigated. It is shown that the use of the Fermi distribution for light nuclei is justified for large momentum transfer. (J.W.R.)

49456 TWO-DIMENSIONAL SOFT ROTATOR IN A THEORY OF NUCLEAR ROTATION. Mikhailov, I. N.; Nadjakov, E.; Karadjov, D.; Sivriev, I.; Piperova, Y. (Joint Inst. for Nuclear Research, Dubna, USSR. Inst. of Physics, Sofia). Compt. Rend. Acad. Bulg. Sci., 22: 635-8(1969).

The two-dimensional soft rotator model was analyzed using the collective variable method. Calculations were performed for the matrix elements of the angular collective variable and the results were in good agreement with other calculations. The method also reproduced correctly the sign and magnitude of the expansion coefficients of the rotational energy. (J.W.R.)

49457 THREE-DIMENSIONAL DESCRIPTION OF NUCLEAR ROTATION BY THE METHOD OF COLLECTIVE VARIABLES. Nadjakov, E.; Piperova, Y.; Karadjov, D.; Sivriev, I. (Inst. of Physics, Sofia). Compt. Rend. Acad. Bulg. Sci., 22: 639-42 (1969).

A method for the description of two-dimensional nuclear rotation, which uses collective variables canonically conjugated to the angular momentum operator, is extended to the case of three-dimensions. The three-dimensional correction to the two-dimensional nuclear moment of inertia is small. (J.W.R.)

49458 CONFIGURATION MIXING EFFECTS IN DIRECT REACTIONS. Prakash, A.; Austern, N. (Univ. of Pittsburgh). Ann. Phys. (N. Y.), 51: 418-60(Feb. 15, 1969).

The "direct" transfer of a nucleon in stripping and pick-up reactions is a more complicated process than suggested by the picture of insertion of the nucleon into a single-particle well; for an accurate evaluation of the form factors one should take into account configuration mixing in the target and residual nuclei. Form-factor equations, previously derived by Pinkston and Satchler and by Berggren, are rederived by an alternative variational method. A general method for practical calculations of form factors by solving these equations is given. The method can be regarded as a one-step iteration of the form factor equations in which the inhomogeneous term is approximated from the usual shell-model calculation. Such "structure-stripping" calculations are performed for ^{58}Ni, ^{57}Ni and the resulting form factors are used to study (p,d) and (d,t) reactions on ^{58}Ni. In the (p,d) calculations a somewhat improved fit is obtained for the angular distribution for the $f_{\frac{5}{2}}$ pick-up to the 0.78-MeV($\frac{5}{2}^-$) state of ^{57}Ni. The remaining discrepancy between theory and experiment shows that effects other than those relating to the form factor must also be examined to explain the observed angular distribution. The ^{58}Ni(d,t)^{57}Ni calculation for the $f_{\frac{5}{2}}$ pick-up indicates that the spectroscopic factor obtained by using the conventional "well-depth" (or "separation-energy") prescription for the form factor can be in error by as much as 50%. A simpler phenomenological method to generate form factors is also given. This method uses the same Saxon–Woods parameters (V_0, R_0, a, $V_{s.o.}$) for calculating all form factors for transitions between two given nuclei, and, at the same time, ensures a correct tail (governed by the actual separation energy) for each form factor. This method is of restricted applicability. (auth)

49459 THE EFFECT OF DIRECT REACTIONS ON THE COMPOUND NUCLEAR-REACTION AMPLITUDE IN A SOLUBLE MODEL. Mekjian, A. Z. (Rutgers - The State Univ., New Brunswick, N. J.). Nucl. Phys., A134: 241-64(1969).

A soluble model for nucleon-nucleus scattering is presented. The model is studied using the K-matrix theory of nuclear reactions in a projected formalism in order to investigate the effect of direct reactions on the compound nuclear-reaction amplitude. The effect of these direct transitions is shown to lead to an energy-dependent renormalization of the widths and energies of the compound nuclear discrete states. This renormalization is shown to be expressible in terms of a new coupling constant for the residual separable interaction strength, which has a critical value for large values of the interaction strength. The model is also used to study these renormalizations in a perturbation expansion, and the convergence of the perturbation theory is then examined. A discussion of the divergence of the perturbation series and the appearance of quasi-bound states is given. The convergence of the Born series for the T-matrix and K-matrix is compared. The continuum damping of the energy shift of a coherent state is examined. A discussion of the threshold behavior of continuum-continuum transitions and the coherent effect of many channels in damping the shift of such states is given. An analytically soluble model for studying quasiparticle scattering and isobaric analog resonances is given. (auth)

49460 DETOUR TRANSITIONS IN INTERNAL BREMSSTRAHLUNG. Ford, G. W.; Martin, C. F. (Univ. of Michigan, Ann Arbor). Nucl. Phys., A134: 457-69(1969).

The contribution of so-called detour transitions to the internal bremsstrahlung accompanying nuclear beta decay is calculated. These are transitions in which the nucleus rather than the electrons radiates the photon. It is shown that such contributions will in general be important for forbidden beta decays. For the unique first-forbidden case, the photon spectrum, angular correlation and polarization are calculated explicitly. (auth)

49461 DEUTERON SCATTERING IN TERMS OF PROTON AND NEUTRON SCATTERING. Rihan, T. H.; Sharaf, M. A. (International Centre for Theoretical Physics, Trieste, Italy). Nucl. Phys., A134: 369-75(1969).

The second iterative solution to the Faddeev equations is adopted for the deuteron scattering on massive target nuclei. With the aid of some reasonable approximations, the deuteron amplitude is factored into proton and neutron amplitudes. A simplified version of the diffraction model picture is used for calculating the latter amplitudes. Comparison with the deuteron elastic scattering data at 52 MeV on ^{58}Ni shows satisfactory agreement. (auth)

49462 FIRST-ORDER BINDING ENERGIES AND SPECTRA WITH A POTENTIAL MATRIX DEDUCED FROM PHASE SHIFTS. Dey, J.; Elliott, J. P.; Jackson, A. D.; Mavromatis, H. A.; Sanderson, E. A.; Singh, B. (Univ. of Sussex, Eng.). Nucl. Phys., A134: 385-95(1969).

The matrix elements deduced from phase shifts in an earlier paper are used in first-order perturbation-theory calculations for closed-shell nuclei and for nuclei with one or two particles or holes. Nuclear matter is also studied in the same approximation. (auth)

49463 NON-RIGIDITY IN ALPHA SCATTERING FROM DEFORMED NUCLEI. Glendenning, N. K.; Mackintosh, R. S. (Univ. of California, Berkeley). Phys. Lett., 29B: 626-8(Aug. 18, 1969).

Phenomenological vibrational wavefunctions have been used to determine the effect of nuclear non-rigidity on inelastic scattering within the ground band and to calculate the cross-section of vibrational levels in strongly deformed nuclei. (auth)

49464 THE NATURE OF THE GAMMA BAND IN ERBIUM AND DYSPROSIUM. Mackintosh, R. S. (Univ. of California, Berkeley). Phys. Lett., 29B: 629-31(Aug. 18, 1969).

The angular distribution of 50 MeV alpha particles corresponding to the gamma band levels of ^{166}Er has been calculated in terms of a phenomenological model including a hexadecapole vibration. (auth)

49465 LONG-RANGE PART OF THE EFFECTIVE INTERACTION BETWEEN QUASIPARTICLES IN NUCLEI. Khodel, V. A.; Saperstein, E. E. (Inst. of Atomic Energy, Moscow). Phys. Lett., 29B: 632-4(Aug. 18, 1969).

The origin and the form of long-range parts of the effective interaction between quasiparticles in nuclei were analyzed. The contributions of these parts to matrix elements of the effective interaction are evaluated. (auth)

49466 THE EFFECT OF EXCITED 0^+ STATES ON THE ft VALUES OF SUPERALLOWED BETA DECAYS. Logue, L. J. (Univ. of Sussex, Brighton, Eng.). Phys. Lett., 29B: 642-4 (Aug. 18, 1969).

The effect of including an excited 0^+ state in the sum over intermediate nuclear states which occurs in electromagnetic corrections to superallowed beta decays is investigated and found to be too small to account for the variation of ft values. (auth)

49467 A VERY SOFT CORE POTENTIAL MODEL FOR $^1S_0$ NEUTRON–PROTON SCATTERING. Srivastava, M. K.; Banerjee, P. K.; Sprung, D. W. L. (McMaster Univ., Hamilton, Ont.). Phys. Lett., 29B: 635-7(Aug. 18, 1969).

A new shape potential was fitted to n–p $^1S_0$ phase shift data. It is local and static, has a repulsive core of height under 125 MeV and half radius 0.7 fm and an attractive well weaker than common potentials. It agrees with one pion exchange at large radii. Existing phase shifts are thereby shown not to require a substantial repulsion, and the binding energy of nuclear matter is brought closer to agreement with experiment. (auth)

49468 ALPHA-PARTICLE EMISSION: VIOLATION OF THE USUAL INTERPRETATION OF QUANTUM MECHANICS. Robinson, M. C. (McGill Univ., Montreal). Phys. Lett., 30A: 69-70 (Sept. 8, 1969).

It is shown that α-particle emission contradicts the usual interpretation of quantum mechanics, but is in agreement with the first guided particle model proposed by Bohm. (auth)

49469 COULOMB FUNCTIONS FOR COMPLEX ENERGIES. Tamura, Taro; Rybicki, Frank (Univ. of Texas, Austin). Comput. Phys. Commun., 1: 25-30(July 1969).

A computer program was written for calculation of regular and irregular Coulomb functions and their derivatives for complex energies. The program was written in FORTRAN IV for the CDC 6600. (B.G.D.)

49470 DYNAMIC ORIENTATION OF NUCLEI WITH SPIN >1. Gupta, S. K.; Narchal, M. L. (Punjabi Univ., Patiala, India). Appl. Opt., 8: 1677-80(Aug. 1969).

The dynamic orientation of nuclei with spin >1 is theoretically investigated in experimental samples where the nucleus is in well resolved hyperfine interaction with a paramagnetic ion of spin $\frac{1}{2}$. It is shown that the contribution from off-diagonal elements of the relevant density matrix vanishes in the steady state, and the rate equation approach is justified. The nuclear orientation parameters are computed using the simplified method of partial distributions, both at low and high temperatures, and numerical results are presented for Pa^{4+} in Cs_2ZrCl_6. (auth)

49471 PHENOMENOLOGICAL TREATMENT OF ANHARMONIC EFFECTS IN Cd ISOTOPES. Bes, D. R. (Carnegie Mellon Univ., Pittsburgh. Univ. of Minnesota, Minneapolis); Dussel, G. G. Nucl. Phys., A135: 1-24(1969).

The phenomenological description of anharmonic effects in Cd isotopes is tested. Only third order anharmonicities are taken into account. A criterion for the range of validity of the model is given. Comparison of the results with the experimental energies, electromagnetic transition rates and one-body transfer reactions shows that the theoretical predictions are generally improved by the presence of anharmonic terms. However, aside from the static quadrupole moment, the improvement is not spectacular, and therefore, its significancy in testing the adequacy of the anharmonic adiabatic description is questionable. Two sets of single-particle energies, both reproducing the levels of odd nuclei, are obtained as a byproduct of the calculation. (auth)

49472 MICROSCOPIC TREATMENT OF ANHARMONIC EFFECTS IN Cd ISOTOPES. Bes, D. R. (Carnegie Mellon Univ., Pittsburgh. Univ. of Minnesota, Minneapolis); Dussel, G. G. Contract AT(11-1)-1764. Nucl. Phys., A135: 25-35 (1969).

Two microscopic methods are applied in order to calculate the third-order parameters in the anharmonic description of Cd isotopes. The first one (based on the quasi-boson expansion) failed to reproduce the empirical variation of the static quadrupole moment with A. An alternative method is presented which takes into account renormalization effects, but it is not able to calculate the velocity dependent terms in the anharmonic Hamiltonian. The results of the second calculation are in better agreement with the empirical values than those obtained with the previous method. (auth)

49473 CALCULATION OF K, L, M AND N BINDING ENERGIES AND K X-RAYS FOR ELEMENTS FROM Z = 96 TO 120. Carlson, Thomas A.; Nestor, C. W. Jr.; Malik, F. B.; Tucker, Thomas C. (Oak Ridge National Lab., Tenn.). Nucl. Phys., A135: 57-64(1969).

Atomic parameters should be of great help in identifying the new superheavy nuclei, since x-rays resulting from internal conversion and electron capture are characteristic of the daughter element; and the energies of internal conversion electrons are dependent on the atomic binding energies. Therefore, the inner-shell binding energies and K x-ray energies for the heavy and superheavy elements have been calculated from solutions of relativistic Hartree–Fock–Slater atomic wave functions employing a finite nuclear size. After adding a small semi-empirical correction, it is believed that the final results for x-ray energies are accurate to the order of 0.1%. (auth)

49474 PROPERTIES OF THE RPA THEORY OF NUCLEAR SCATTERING. Hahne, F. J. W.; Dover, Carl B. (Univ., Heidelberg). Nucl. Phys., A135: 65-90(1969).

The analytic properties of the S-matrix for particle-hole scattering are examined within the framework of the random phase approximation (RPA). In contrast to the Tamm–Dancoff approximation (TDA) or the case of scattering from cutoff potentials, the RPA S-matrix displays left-hand singularities in the E-plane, which are due to the existence of ground state correlations. For S(E), the Riemann surface is constructed and the motion of poles investigated. In the k-plane, S(k) is expressed in terms of an appropriately defined Jost function. A pole decomposition of S(E) is obtained, and sum rules relating total and partial widths are derived and their range of validity explored. Some consequences of these sum rules are studied in simple cases. (auth)

49475 SURFACE PEAKING IN THE CALCULATED IMAGINARY PART OF THE OPTICAL-MODEL POTENTIAL. Ahmad, I.; Rahman Khan, M. Z. (Aligarh Muslim Univ., India). Nucl. Phys., A135: 91-6(1969).

Calculations of the imaginary part of the optical-model potential using the Thomas–Fermi gas model of the nucleus are discussed. The surface peaking obtained in earlier calculations of the imaginary distribution is shown to be due to an inappropriate assumption regarding the kinetic energy of the incident nucleon inside the nucleus. No surface peaking is obtained if the kinetic energy is calculated in an appropriate way. (auth)

49476 CORE POLARIZATION EFFECTS SEEN BY pp' SCATTERING ON NUCLEI WITH ONE OPEN SHELL. Schaeffer, R. (CEN, Saclay, Gif-sur-Yvette, France). Nucl. Phys., A135: 231-40(1969).

The microscopic DWBA has proven to be a good spectroscopic tool provided antisymmetrization is included. It is therefore used here to test microscopic wave functions for the collective levels of nuclei with one closed shell. These nuclei are described by the BCS + RPA theory which includes particle-hole polarization of the closed core. This theory is found to give good results for the 3^- states, but to underestimate the closed shell excitations of the 2^+ states. Using both pp' and ee' scattering experiments, the relative importance of proton and neutron excitations in the nucleus is also given. In all the cases, these two excitations are found to be of the same magnitude for the lowest collective states which are therefore almost pure $\Delta T = 0$ excitations. (auth)

49477 COMPUTATION OF TOTAL, DIFFERENTIAL, AND DOUBLE-DIFFERENTIAL CROSS SECTIONS FOR COMPOUND NUCLEAR REACTIONS OF THE TYPE (a,b) (a,bγ), AND (a,bγ-γ). II. GENERALIZED PROGRAMS "MANDY" AND "BARBARA" FOR ARBITRARY ANGULAR MOMENTA IN HAUSER–FESHBACH–MOLDAUER FORMALISM. Sheldon, Eric; Strang, Richard Michael (Univ. of Virginia, Charlottesville). Comput. Phys. Commun., 1: 35-54(July 1969).

Two computer programs were written for calculation of total and differential cross sections in absolute and normalized form for angular distributions in low-energy nuclear reactions of the type (a,b), (a,bγ), or (a,b$\gamma\gamma$) according to statistical compound nucleus theory in j–j coupling formalism. The program was written in ALGOL for the Burroughs B5500. (B.G.D.)

49478 NUCLEAR BOUND STATE WAVE FUNCTION SUBROUTINE. Smith, William R. (Trinity Univ., San Antonio). Comput. Phys. Commun., 1: 55-63(July 1969).

A computer program was written which numerically integrates the radial Schroedinger equation including a central Woods–Saxon potential and spin-orbit coupling for the case of a particle bound in the nuclear and Coulomb force field of a core nucleus. An important use of the program is to provide single particle wave functions required in direct nuclear reaction calculations. The program was written in FORTRAN for the IBM 360/44. (B.G.D.)

49479 PRESENT STATUS OF THE NUCLEAR THREE-BODY PROBLEM. Delves, L. M. (Univ. of Sussex, Eng.); Phillips, A. C. Contract AT(30-1)-2098. Rev. Mod. Phys., 41: 497-530 (July 1969).

The emphasis in this review is on the extent to which theoretical studies have accounted for the empirical data on the three-nucleon systems. The ground, excited, and continuum states of the nuclear three-body systems are discussed, and a symmary is given of the interpretation of the electromagnetic- and weak-interaction properties. (auth)

49480 QUASIMOLECULAR NUCLEAR OPTICAL POTENTIALS. Scheid, Werner; Greiner, Walter (Univ., Frankfurt am Main). Z. Phys., 226: 364-94(1969).

A theory is presented to calculate potentials for the elastic nuclear heavy-ion scattering in a phenomenological way. The density properties of finite nuclei are derived with a schematic ansatz for the interaction energy between nuclear matter. The same interaction energy is applied to the calculation of the real part of the heavy-ion potential, which is of the quasimolecular type. The imaginary part is connected with the outflow time of nuclear matter out of compressed regions of overlapping nuclei. The resulting cross section for the elastic $^{16}O-^{16}O$ scattering reproduces the experiment up to 30 MeV quite well. An effective compression modulus of the ^{32}S compound system can be deduced from the scattering experiment. It results to be about 200 MeV. (auth)

49481 PAIRING IN NUCLEI. Johns, Oliver Davis. Berkeley, Calif., Univ. of California, 1968. 203p.

Thesis.

The general problem of adapting the quasi-particle approximation to give satisfactory results in nuclear systems is dealt with. It is shown that the projection of correct particle number from the number nonconserving quasi-particle ground state vector can give excellent agreement with exact ground states, when the quasi-particle ground state is first modified by an exponential four, eight, etc., quasi-particle operator. The similarity of this ground state exponential form to that predicted by the quasi-boson method leads the generalized problem of computing both ground and excited seniority zero 0+ states of nuclei. The results demonstrate that excellent overlap of boson and exact 0+ states is obtained if the following revisions are made in the quasi-boson method: (1) The zero energy boson used to help define the boson ground state should be a certain linear sum of the spurion and its conjugate, and not the spurion alone. (2) The first excited state for moderate to weak pairing potential strength is a two boson state consisting of one zero energy boson and one non-zero energy boson. (3) The striking failure of the method at subshell closures can be circumvented by slightly altering the average particle number. The method of exact, number conserving diagonalization of the many body Hamiltonian matrix is illustrated. This method, which is practical only for nondeformed nuclear systems, is conceptually simpler than the quasi-particle method in which much effort must go into the isolation and correction of approximation produced inaccuracies. (Diss. Abstr.)

49482 MANY-PARTICLE TRANSFER REACTIONS. THE (^{6}Li,p) STRIPPING REACTION. Dumitrescu, Ovidiu (Joint Inst. for Nuclear Research, Dubna, USSR. Bucharest Univ.). Rev. Roum. Phys., 14: 271-85(1969).

The explicit expression of the matrix element for (^{6}Li,p) stripping reactions with finite range interaction for both spherical and deformed nuclei is given. (auth)

49483 PROPERTIES OF THE ALPHA PARTICLE. Van Dyke, Peter Davies. Bethlehem, Pa., Lehigh Univ., 1968. 235p.

Thesis.

Two methods for classifying the total wave function of few-nucleon systems are discussed in some detail. It is shown why one of these methods, the operator method, is the more suitable one for the four-nucleon alpha particle system. Using a slight modification of Cohen's classification of the alpha particle wave functions, convenient expansion is obtained of the total alpha particle wave function into a complete set of classified wave functions. Applying a Euler–Lagrange variational technique to Schroedinger's equation for the total wave function, which is represented by its corresponding set of classified wave functions, a general system of coupled integrodifferential equations for the best pair wave functions of the alpha particle is obtained. It is shown that in the case of Cohen's classification, the procedure of summing out the spins plays an important role in expressing the integrodifferential equations in terms of the inter-particle distances only, without ever having to explicitly consider the Euler angles, which orient the system of four particles. A Gaussian wave function approximation is used to generate two ways for analytically reducing the 5-dimensional integral coefficients, which appear in the coupled integrodifferential equations, to 1 and 2-dimensional numerical integrals that are easily computed with a high speed digital computer. The general system of coupled integrodifferential equations is reduced to a set of two coupled integrodifferential equations for the principal S and D-state wave functions of the alpha particle. Neglecting the D-state wave function, an accurate, approximate numerical solution is obtained for the single integrodifferential equation describing the principal S-state wave function; a realistic central hard core potential is employed which gives a good fit to the two-body low energy nuclear data. Using this principal S-state wave function, satisfactory results are obtained for the binding energy and charge form factors of the alpha particle. One of two Monte Carlo methods, which are described in detail, is used to evaluate the multi-dimensional integrals which yield these observables. Including the tensor interaction, which couples the principal S and D-state wave functions, the corresponding two coupled integrodifferential equations are further developed in detail so that they are ready for an accurate, numerical solution. Although this solution is not carried out, all the details of the techniques for the solution procedure are developed, and it is shown that the numerical solution is quite feasible with present computing capabilities. (Diss. Abstr.)

49484 THREE-PARTICLE MODEL FOR DEUTERON-INDUCED REACTIONS. Fuller, Richard Clair. Madison, Wis., Univ. of Wisconsin, 1968. 116p.

Thesis.

The work was motivated by a desire to consider low-energy deuteron induced reactions within the framework of three-particle scattering theory. Neglecting target or "core" excitations, major emphasis is given to resonances of the (A + 2) particle "compound nucleus" system which are unstable to two-particle emission and can be described in shell model terms as superpositions of two single particle-core resonances (or one resonance and one particle-core bound state). Such a theory would presumably be appropriate for considering reactions induced by a low energy deuteron incident on a closed shell nucleus such as an alpha particle. To this end, three-particle scattering theory is formulated in terms of single particle-core "reduced potentials," designed to facilitate the isolation of single particle-core resonant and bound states contributions to the particle-core Green's functions. This is accomplished by introducing a generalized inner product for resonance wave functions, using a definition based on the fact that these wave functions satisfy the homogeneous Lippmann–Schwinger equation. The two-particle Green's function for two noninteracting particles outside a closed-core is then considered and the singular contributions to it from single-particle bound and resonant states are isolated using the results and insights obtained from the single-particle considerations. Resonant scattering amplitudes for a deuteron incident on a closed core nucleus are discussed using this decomposition of the two particle Green's function. (Diss. Abstr.)

REACTOR TECHNOLOGY

Commercial Power Reactors

Refer also to abstracts 47673, 47678, 47719, 48381, and 49658.

49485 (DOCKET-1153-2) HALLAM NUCLEAR POWER FACILITY: HYDRAULIC TEST OF MAIN HEAT TRANSFER SYSTEM. Post Critical Test Completion Report. (Atomics International, Canoga Park, Calif.). Feb. 7, 1964. Contract AT(11-1)-Gen-8. 43p. (AI-PC-510). Dep. CFSTI.

For Consumers Public Power District, Hallam, Nebr.

The hydraulic characteristics of the Hallam Power Reactor main cooling system are measured. Tests were performed under isothermal conditions and during power operation. (D.C.C.)

49486 (DOCKET-1153-3) HALLAM NUCLEAR POWER FACILITY: HEAT TRANSFER TESTS. Post Critical Test Completion Report. (Atomics International, Canoga Park, Calif.). Feb. 10, 1964. Contract AT(11-1)-Gen-8. 40p. (AI-PC-530). Dep. CFSTI.

For Consumers Public Power District, Hallam, Nebr.

The results of 10 heat transfer tests performed during the use-to-power testing program are presented. The tests were performed to verify the performance of the steam generators and intermediate heat exchangers. The first four tests were performed at low power levels, the highest being 38 MW(t) or 15% full load. The remaining six tests were performed during power increases to full power. (D.C.C.)

49487 (DOCKET-50003-6) INDIAN POINT STATION, UNIT NO. 1. REPORT OF WELD FAILURE IN PRIMARY PIPING. (Consolidated Edison Co. of New York, Inc., New York). Sept. 12, 1969. 2p. Dep. CFSTI.

A weld failure in the vent line connection of the No. 132 primary coolant pump resulted in shutdown of Unit 1 to repair the leak. The circumstances associated with the weld failure detection and subsequent vent line rewelding are described. (H.D.R.)

49488 (DOCKET-50003-9) STRESS ANALYSIS OF REACTOR VESSEL INTERNALS AND SUPPORT SKIRT FOR SUBCOOLED PHASE OF INDIAN POINT UNIT NO. 1 BLOWDOWN. (Consolidated Edison Co. of New York, Inc., New York). Sept. 1969. 137p. Dep. CFSTI.

The ability of the reactor internal structures to withstand the effects of short term transient pressure pulses from the subcooled phase of blowdown following the loss of coolant accident (LOCA) is evaluated. The LOCA postulated is a double-ended break of the largest hot or cold leg coolant pipe followed by loss of coolant from the primary system. Separate sections describe: (1) the postulated LOCA; (2) the design and construction of the reactor vessel intervals; (3) the techniques, criteria, and methods used in the analyses; and (4) an evaluation of the results of the analyses. The analysis shows that the LOCA would not cause fuel damage, significant changes in the geometry of the vessel internals, or any other effect that could impair core cooling or prevent control rod motion. Appendices provide details on the models used to analyze the grid plates, an analysis of the ability of the support skirt to sustain the overturning moments from the LOCA, and an analysis of the distribution of postulated accident forces transmitted to the core internals. (H.D.R.)

49489 (DOCKET-50010-48) DRESDEN NUCLEAR POWER STATION, UNIT 1. Report of Startup with Off-Gas Value in Off Position. (Commonwealth Edison Co., Chicago, Ill.). Aug. 14, 1969. 2p. Dep. CFSTI.

An investigation of the cause of abnormal radiation levels in the turbine building when the unit load was raised following startup revealed a double failure involving the off-gas valve position indicator and the valve operator. The sequence of events that occurred during the startup and the subsequent repairs that were made are described. (H.D.R.)

49490 (DOCKET-50010-49) DRESDEN NUCLEAR POWER STATION, UNIT 1. Control Rod Malfunction Report. (Commonwealth Edison Co., Chicago, Ill.). Aug. 14, 1969. 2p. Dep. CFSTI.

Experience with abnormal latching of two control rod drives is described. Repeated exercising and flushing of the drives corrected the malfunctions. (H.D.R.)

49491 (DOCKET-50016-25) ENRICO FERMI ATOMIC POWER PLANT, [UNIT 1]. Failure of Containment Isolation System. (Power Reactor Development Co., Detroit, Mich.). Sept. 26, 1969. 2p. Dep. CFSTI.

The failure of an above floor pressure detection and recorder system to actuate containment closure during a scheduled check of the containment isolation system is reported. (H.D.R.)

49492 (DOCKET-50029-98) YANKEE NUCLEAR POWER STATION. License No. DPR-3: Technical Specifications, Change No. 89. (Yankee Atomic Electric Co., Boston, Mass.). Sept. 15, 1969. 2p. Dep. CFSTI.

A proposed change in the Technical Specifications to allow the replacement of four test assemblies containing Zircaloy clad rods with four standard assemblies in the Core VIII loading is authorized. (H.D.R.)

49493 (DOCKET-50029-99) YANKEE NUCLEAR POWER STATION. License No. DPR-3: Technical Specifications, Change No. 90. (Yankee Atomic Electric Co., Boston, Mass.). Sept. 22, 1969. 3p. Dep. CFSTI.

Authorization to operate the reactor with the number of locations at which flux wires can be inserted into the core reduced from 18 to 7 is requested. (H.D.R.)

49494 (DOCKET-50146-40) SAXTON REACTOR. License No. DPR-4: Technical Specifications, Change No. 32, Amendment 4. (Saxton Nuclear Experimental Corp., Pa.). Sept. 1969. 154p. Dep. CFSTI.

The Saxton Core III configuration contains 7 Pu assemblies, 2 enriched UO_2 assemblies, 11 partially depleted UO_2 assemblies from Core I, and one unirradiated UO_2 assembly. Detailed information is presented on the Core III design, irradiation program objectives, operating conditions, and general operating procedures. A safety analysis of the proposed operation is included. (H.D.R.)

49495 (DOCKET-50146-41) SAXTON REACTOR. License No. DPR-4: Amendment 5 to Technical Specifications Change No. 32. (Saxton Nuclear Experimental Corp., Pa.). Sept. 19, 1969. 80p. Dep. CFSTI.

Answers to questions concerning a request to allow-operation of the reactor with Core III at a maximum power level of 28 MW(t) are presented. The Technical Specifications and an analysis of short term atmospheric dilution factors are included. (H.D.R.)

49496 (DOCKET-50213-18) CONNECTICUT YANKEE ATOMIC POWER PLANT. Operation Report No. 69-8, August 1969. (Connecticut Yankee Atomic Power Co., Boston, Mass.). Sept. 11, 1969. Contract AT(30-1)-3250. 17p. (NYO-3250-38). Dep. CFSTI.

49497 (DOCKET-50244-26) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT NO. 1. Addendum to the Safety Evaluation. (Rochester Gas and Electric Corp., N. Y.). Sept. 19, 1969. 3p. Dep. CFSTI.

Information concerning Class 1 piping analysis for the cooling system piping, 2 inch and smaller piping, and 2.5 inch and larger piping is presented. Results of heat transfer tests of the cooler tubes, fan motor tests, and process instrument transmitters are presented. (D.C.C.)

49498 (DOCKET-50263-24) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Final Safety Analysis Report, Amendment 17. (Northern States Power Co., Minneapolis, Minn.). Sept. 15, 1969. 112p. Dep. CFSTI.

Data concerning predicted airborne radioactivity release points and concentration of liquid radioactive waste in radwaste tanks are presented. Reactor pressure vessel testing limits are described. The containment system capabilities for a post-accident environment are discussed. Dose rates for the control room after a loss-of-coolant accident are listed. Thermal and hydraulic transients following a loss-of-coolant accident are described. The performance capabilities of one and two emergency core spray systems are illustrated. Diagrams of piping systems are included. Reactor control rod drive system limitations are included. Reactor control rod drive system limitations are described. Seismic requirements for instrumentation are classified. (D.C.C.)

49499 (DOCKET-50263-26) MONTICELLO NUCLEAR GENERATING PLANT, [UNIT NO. 1]. [Facility Description and Safety Analysis Report], Amendment 18. (Northern States Power Co., Minneapolis, Minn.). Sept. 19, 1969. 7p. Dep. CFSTI.

A letter is presented which states that the required review of the pressure vessel stress analysis report has been completed. (D.C.C.)

49500 (DOCKET-50269-9) OCONEE NUCLEAR STATION, UNITS 1, 2, AND 3. Final Safety Analysis Report, Amendment 8.

(Duke Power Co., Charlotte, N. C.). Sept. 15, 1969. 199p. (DOCKET-50270-9; DOCKET-50287-6). Dep. CFSTI.

System classifications for the plant piping systems are listed. Schematic diagrams of the cooling system, piping system, spray system, high and low pressure injection systems, emergency systems, and waste disposal system are included. Procedures and inspection requirements for field welding are described. Prestressing procedures are also described. Revised physics measurements for the plant are included. (D.C.C.)

49501 (DOCKET-50282-9) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, RED WING, MINNESOTA, UNITS 1 AND 2. Construction Permits Nos. CPPR-45 and 46: Supplemental Information. (Northern States Power Co., Minneapolis, Minn.). Aug. 29, 1969. 10p. (DOCKET-50306-9). Dep. CFSTI.

Additional information is presented concerning the leak detection system for the emergency core cooling facilities. The alternate emergency water supply system is described. The vent system for the auxiliary building and the reactor cavity flooding facilities are also described. (D.C.C.)

49502 (DOCKET-50282-11) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, [UNITS 1 AND 2]. Report of Damage Caused by Fire on March 31, 1969 and Repair of Fire Damaged Structure. (Northern States Power Co., Minneapolis, Minn.). July 25, 1969. 274p. (DOCKET-50306-11). Dep. CFSTI.

The damage caused by the fire in the concrete framework of the Prairie Island Power Reactor Units 1 and 2 is described. Repair methods are discussed. (5 references) (D.C.C.)

49503 (DOCKET-50309-16) MAINE YANKEE ATOMIC POWER STATION. Containment Wall Design. (Maine Yankee Atomic Power Co., Wiscasset). Sept. 26, 1969. 3p. Dep. CFSTI.

Revised information is presented concerning the stresses which may be exerted on the containment wall. The region around the equipment hatch is analyzed for tangential shear. (D.C.C.)

49504 (DOCKET-50323-9) DIABLO CANYON, UNIT 2. Preliminary Safety Analysis Report, Amendment 6. (Pacific Gas and Electric Co., San Francisco, Calif.). Sept. 25, 1969. 13p. Dep. CFSTI.

Revised information is presented concerning radioisotope concentrations in discharges from the Diablo Canyon Power Reactor Unit 2. Vertical temperature gradient conditions with low wind speeds at the reactor site are listed. (D.C.C.)

49505 (DOCKET-50327-7) SEQUOYAH NUCLEAR PLANT, UNITS 1 AND 2. Preliminary Safety Analysis Report, Amendment 4. (Tennessee Valley Authority, [Knoxville]). Sept. 5, 1969. 479p. (DOCKET-50328-7). Dep. CFSTI.

Questions with respect to the plant design and safety are specifically answered. Revisions of pages and sections of the PSAR are included. Included in appendices are data on stresses in bedrock below reactor buildings and dynamic testing of reactor foundations. (H.D.R.)

49506 (DOCKET-50331-10) DUANE ARNOLD ENERGY CENTER. Preliminary Safety Analysis Report, Amendment 4. (Iowa Electric Light and Power Co., Cedar Rapids). Aug. 18, 1969. 138p. Dep. CFSTI.

Questions with respect to the plant design and safety are specifically answered. Revisions to pages and sections of the PSAR are included. (H.D.R.)

49507 (DOCKET-50331-11) DUANE ARNOLD ENERGY CENTER. Preliminary Safety Analysis Report, Amendment 5. (Iowa Electric Light and Power Co., Cedar Rapids). Aug. 26, 1969. 200p. Dep. CFSTI.

Additional and revised information concerning the Duane Arnold Power Reactor is presented. The population distribution and growth rates for the surrounding area of the reactor site are listed. River flood and low flow stages are analyzed. Environmental monitoring systems are described. Soil analysis for the reactor site is presented. Leak detection systems for the reactor are described. Radiation effects on the pressure vessel material are analyzed. Seismic and vibration design of the piping system is described. Seismic design of the containment structure is analyzed. Stress and strain limits for Class 1 component supports are presented. Radwaste system is described. Feasibility of tornado removal of spent fuel pool water is analyzed. The effects of tornado winds on containment structure loading are analyzed. The quality assurance program is outlined and described. (D.C.C.)

49508 (DOCKET-50333-7) JAMES A. FITZPATRICK NUCLEAR POWER PLANT. Preliminary Safety Analysis Report, Amendment 4, Suppl. 3. (Power Authority of the State of New York). Sept. 29, 1969. 8p. Dep. CFSTI.

Revised design configurations for the reactor building substructure is included. A modified construction sequence for the reactor building is also described. (D.C.C.)

49509 (DOCKET-50334-7) BEAVER VALLEY POWER STATION. Preliminary Safety Analysis Report, Amendment 4, Vol. 4. (Duquesne Light Co., Pittsburgh, Pa.). Sept. 3, 1969. 975p. Dep. CFSTI.

Questions with respect to the design and safety of the plant are specifically answered, and revisions to pages and sections of the PSAR are presented. Detailed reports on subsurface conditions and seismic velocity measurements at the plant site are included. The comments and responses concern: site, coolant system, containment, engineered safeguards, instrumentation and control, electrical systems, auxiliary and emergency systems, radioactive wastes and radiation protection, conduct of operations, safety analyses, and quality assurance. (H.D.R.)

49510 (DOCKET-50334-8) BEAVER VALLEY POWER STATION. ANALYSIS OF FOUNDATION VIBRATIONS. (Duquesne Light Co., Pittsburgh, Pa.). Sept. 16, 1969. 23p. Dep. CFSTI.

A reprint of a paper on the analysis of vibrations of foundations for reciprocating machines is presented. The theory of dynamic response of foundations to periodic forces is reviewed and data obtained in field tests are examined. (H.D.R.)

49511 (DOCKET-50334-9) BEAVER VALLEY POWER STATION. [Preliminary Safety Analysis Report], Amendment 5. (Duquesne Light Co., Pittsburgh, Pa.). Sept. 18, 1969. 100p. Dep. CFSTI.

Information is presented on the site analysis for Beaver Valley Power Reactor Unit 1. Boring logs and calculation sheets are included. (D.C.C.)

49512 (DOCKET-50335-8) HUTCHINSON ISLAND PLANT, UNIT NO. 1. [Preliminary Safety Analysis Report], Amendment 3. (Florida Power and Light Co.). Sept. 8, 1969. 249p. Dep. CFSTI.

Questions with respect to the design and safety of the plant are specifically answered, and revisions to pages and sections of the PSAR are presented. A supplementary analysis of the probable maximum hurricane tide resulting from the use of an increased value of asymptotic pressure is included. (H.D.R.)

49513 (GEAP-10039) POWER REACTOR HIGH PERFORMANCE UO_2 PROGRAM ANALYSIS OF FISSION PRODUCT RELEASE RELATED TO CENTERMELT FUEL FAILURES. Osborne, R. N.; Holloway, J. H.; Axtell, C. E. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). June 1969. Contract AT(04-3)-189. 17p. (EURAEC-2114). Dep. CFSTI.

Work Performed under United States–Euratom Joint Research and Development Program.

In June 1968, two developmental UO_2 fuel rods failed while operating at high heat rating (27 kW/ft) and with commensurate central melting in the Consumers Big Rock Point reactor. The data and observations accumulated during surveillance of fission product release are presented. Although the failures did occur at very high heat rating, there was no drastic impairment of the reactor operation. A step increase in the off-gas activity of 4,000 to 5000 μCi/sec signaled the onset of failure. Operation continued at the same power level for 3 more days, with only a very gradual increase in off-gas until a power reduction was instituted for other causes. Transient increases to as high as 23,000 μCi/sec occurred accompanying power adjustments but at no time did the off-gas approach levels that interfere with routing reactor operation. 7 references. (auth)

49514 (NP-18011) NUCLEAR POWER ON THE COAST OF THE BALTIC SEA. (Swedish State Power Board, Stockholm). May 1969. 106p. (In Swedish). Dep. CFSTI (U. S. Sales Only).

A study is presented on siting of nuclear power plants in Sweden on the coast of the Baltic Sea. Siting is discussed in terms of development and regional distribution of energy demand, types and sizes of plants, plant safety, water supply, geotechnical aspects recipients and the community at the place of siting. The alternative locations studied are: Gryt, Marviken, Norrkoeping, Oxeloesund Trosa, Nynaeshamn, Dalaroe, Bogesund, and Forsmark. (Sweden)

49515 (TID-25188) GARIGLIANO NUCLEAR POWER PLANT. Operation Report for the 2nd Quarter of 1969. (Ente Nazionale per l'Energia Elettrica, Rome (Italy)). June 30, 1969. 17p. Dep. CFSTI.

Operations and maintenance requirements are described for the Garigliano Power Reactor during April to June 1969. Reactor wa-

ter chemistry and off-gas measurements during the period are presented. Radiation dose measurements for personnel are listed. (D.C.C.)

49516 (TID-25200) GUNDREMMINGEN NUCLEAR POWER PLANT. Monthly Report, November 1967. (Kernkraftwerk RWE-Bayernwerk G.m.b.H., Gundremmingen (West Germany)). 50p. (In German). Dep. CFSTI.

Operations and maintenance requirements for the Gundremmingen Power Reactor are described for the month of November 1967. Personnel radiation doses during the month are listed. (D.C.C.)

49517 (TID-25201) GUNDREMMINGEN NUCLEAR POWER PLANT. Monthly Report, January 1969. (Kernkraftwerk RWE-Bayernwerk G.m.b.H., Gundremmingen (West Germany)). Feb. 17, 1969. 46p. (In German). Dep. CFSTI.

Operations and maintenance requirements during January 1969 are described. Personnel radiation doses during January are listed. (D.C.C.)

49518 (TID-25202) GUNDREMMINGEN NUCLEAR POWER PLANT. Monthly Report, February 1969. (Kernkraftwerk RWE-Bayernwerk G.m.b.H., Gundremmingen (West Germany)). Mar. 13, 1969. 44p. (In German). Dep. CFSTI.

Operations and maintenance requirements during February 1969 are described. Personnel radiation doses during February are listed. (D.C.C.)

49519 (TID-25203) GUNDREMMINGEN NUCLEAR POWER PLANT. Monthly Report, March 1969. (Kernkraftwerk RWE-Bayernwerk G.m.b.H., Gundremmingen (West Germany)). 42p. (In German). Dep. CFSTI.

Operations and maintenance requirements for the Gundremmingen Power Reactor are described for the month of March 1969. Personnel radiation doses during the month are listed. (D.C.C.)

49520 (TID-25204) GUNDREMMINGEN NUCLEAR POWER PLANT. Monthly Report, April 1969. (Kernkraftwerk RWE-Bayernwerk G.m.b.H., Gundremmingen (West Germany)). May 19, 1969. 43p. (In German). Dep. CFSTI.

Operations and maintenance requirements during April 1969 are described. Exhaust gas activity monitoring is analyzed. Personnel radiation doses during April are listed. (D.C.C.)

49521 (TID-25205) GUNDREMMINGEN NUCLEAR POWER PLANT. Monthly Report, May 1969. (Kernkraftwerk RWE-Bayernwerk G.m.b.H., Gundremmingen (West Germany)). 42p. (In German). Dep. CFSTI.

A symmetrical control rod pattern was run on May 2 and no other control rods were moved, up to May 30, to enable a precise determination of the axial and radial power factors to be made after shutdown, via a γ scan. The shutdown at 1600 hrs on May 30 was also used for checking the scram times of all the control rods, the closure times of the steam line penetrations valves and other important parameters. All the data acquired satisfy the requirements of the operating permit. (auth)

49522 (TID-25206) GUNDREMMINGEN NUCLEAR POWER PLANT. Monthly Report, June 1969. (Kernkraftwerk RWE-Bayernwerk G.m.b.H., Gundremmingen (West Germany)). July 16, 1969. 42p. (In German). Dep. CFSTI.

Operations and maintenance requirements during June 1969 are described. Personnel radiation doses during June are listed. (D.C.C.)

49523 (WAPD-TM-904) AGGLOMERATION OF PARTICLES IN TURBULENT FLOW. Beal, S. K. (Bettis Atomic Power Lab., Pittsburgh, Pa.). Sept. 1969. Contract AT-11-1-GEN-14. 21p. Dep. CFSTI.

Preliminary analysis indicates that agglomeration of particles in turbulent flow is competitive with deposition in its effect on the coolant-borne particle size distribution in the Shippingport Reactor. In a typical situation, the agglomeration rate exceeds the deposition rate for particles smaller than 0.01 micrometer. The reverse is true for particles larger than 10 micrometer, and in the range of 0.1 to 1.0 micrometer the two rates are about equal. Comparison of theory and experiment shows poor agreement regarding the magnitude of the agglomeration rate/deposition rate relationship but good agreement regarding the trend of the relationship with Reynolds number, providing some indication that the theoretical concept is basically correct. 10 references. (auth)

49524 (ZJE-46) TEMPERATURE CONDITIONS IN THE SUPPORT SKIRT OF A NUCLEAR REACTOR PRESSURE VESSEL. Juzova, Z.; Klatil, J.; Kunes, J.; Ulrych, B. (Skoda Concern, Pilsen (Czechoslovakia). Nuclear Power Plants Div.). May 1969. 89p. Dep. CFSTI (U. S. Sales Only).

The pressure vessel of the Czechoslovakian A1 power reactor is supported by a skirt designed in the shape of a diverging cone. The area where the skirt is welded to the pressure vessel head is subjected to strong temperature stresses during startup and shutdown. Three separate institutions performed calculations to determine the magnitude of the temperature stresses from the temperature fields in the support skirt and adjacent parts of the pressure vessel. The methods used and the results obtained are presented and compared. (H.D.R.)

49525 CAPABLE NUCLEAR FUEL MANAGEMENT: KEY TO LOWER COSTS. Smith, Earl O. Elec. Light Power (Boston), 47: 135-9(July 1969).

Power reactor fuel management programs are described. Factors which regulate optimum economic fuel cycle management are analyzed. (D.C.C.)

49526 FIVE CASE HISTORIES: NUCLEAR POWER PLANTS IN OPERATION. Coe, Roger (Yankee Atomic Electric Co., Boston). Nucl. News, 12: No. 6, 41-62(June 1969).

Operation experiences are reviewed for Dresden Power Reactor Unit 1, Indian Point Power Reactor Unit 1, San Onofre Power Reactor Unit 1, Yankee Power Reactor, and Connecticut Yankee Power Reactor. (D.C.C.)

49527 CONNECTICUT YANKEE: MONITORING SYSTEM RELIES ON TIME-SHARED COMPUTER. Kushkowski, Peter (Connecticut Yankee Atomic Power Co., Boston). Nucl. News, 12: No. 6, 63-7(June 1969).

A description of the Connecticut Yankee Power Reactor on-line IBM 1800 data acquisition and control system is presented. (D.C.C.)

49528 NUCLEAR DECISIONS HINGE ON MORE THAN ECONOMICS. III. Smith, E. O. Elec. Light Power (Boston), 46: 94-7(Nov. 1968).

A computer study of 1000 MW(e) nuclear and coal-fired units is described which proves that nuclear units are now justified in the areas of long-haul coal. The economics of future units will depend on the amount of investment required. (UKAEA Info. Bull.)

49529 NUCLEAR DECISION HINGE ON MORE THAN ECONOMICS. I. Smith, E. O. Elec. Light Power (Boston), 46: 117-19(Sept. 1968).

Nuclear units can be economically justified now in areas where economic coal and gas are not readily available. They may be justified elsewhere if capital costs hold the line and nuclear fuel costs decline as predicted. Justification of nuclear power plants is discussed. (UKAEA Info. Bull.)

49530 THE GEESTHACHT KSH NUCLEAR PLANTS AND OTHER WEST GERMAN NUCLEAR PROJECTS. Casa, A. F.; Sansone, M. Com. Naz. Energ. Nucl., Notiz., 15: No. 7, 47-55(July 1969). (In Italian).

After reviewing and tabulating the main power plants now under construction or planned in West Germany, the Geesthacht KSH plant is described. (auth)

49531 IMPROVED REACTOR EFFICIENCY DEPENDS ON IN-CORE POWER OSCILLATION CONTROL. MacMillan, J. H. Elec. Light Power (Boston), 46: 69-71(Nov. 1968).

Predictions of the future nuclear plant improvements are discussed. (UKAEA Info. Bull.)

49532 NUCLEAR DIFFICULTIES WILL BE SURMOUNTED. Hosmer, Craig. Elec. World, 171: No. 15, 81-5(Apr. 14, 1969).

Difficulties facing public utilities in developing and operating nuclear power plants are analyzed. Legal procedures involved in obtaining required permits and licenses are described. (D.C.C.)

49533 OYSTER CREEK OVERCOMES DIFFICULTIES, READIES FUEL. Elec. World, 171: No. 15, 86-7(Apr. 14, 1969).

Problems with control rod drive-tube cracks are discussed. Additional safety items such as topper pumps on the core spray system and concrete enclosed emergency diesel generators are described. (D.C.C.)

49534 STANDARDS AND CODES CAN EASE LICENSING PATH. Joslin, Murray. Elec. World, 171: No. 15, 88-9 (Apr. 14, 1969).

The effects of nuclear power industry standards on licensing procedures in the U. S. are analyzed. (D.C.C.)

49535 COOLING LAKES CAN BE A PLEASANT SOLUTION. Eicher, G. J. (Portland General Electric Co., Oreg.). Elec. World, 171: No. 15, 90-2(Apr. 14, 1969).

Advantages and disadvantages of using lakes for power reactor cooling systems are described. Comparison of data with other cooling systems is presented. (D.C.C.)

49536 NUCLEAR POWER IN A BILLION DOLLAR STALEMATE. Elec. Light Power (Boston), 47: No. 4, 55-62(Apr. 1969).

Solutions to the problem of delays in nuclear power plant licensing procedures are discussed. (D.C.C.)

49537 JOSE CABRERA NUCLEAR POWER STATION CAN GENERATE MORE THAN ONE MILLION MWh ANNUALLY. Luz Fuerza, 28: 9-15(Jan. 1969). (In Spanish).

The nuclear power plant consists of a pressurized-water reactor fueled with slightly enriched UO_2. The reactor has a thermal output of 510 MW. The H_2-cooled generator is rated at 177.5 MVA. The various sections of the plant are described and a table of principal design data is given. (UKAEA Info. Bull.)

49538 ROLE OF ENVIRONMENTAL MONITORS AT THE TIME OF A REACTOR ACCIDENT. Ito, Naoji (Japan Atomic Energy Research Inst., Tokyo). Nippon Genshiryoku Gakkaishi, 11: 544-9(1969). (In Japanese).

The role of environmental monitors located in a nuclear power plant is analyzed for accident conditions. Monitor locations for optimum performance and observation are described. Inhaled I_2 generally constitutes the most critical radiation hazard in a reactor accident. The effectiveness of the monitors should be judged by the ability to evaluate the prevailing hazard of inhaled I_2 in such an event. 6 references. (auth)

49539 MILE FROM TIMES SQUARE. Novick, Sheldon (American Society of Mechanical Engineers, New York). Environment, 11: 10-15; 39(Jan.-Feb. 1969).

The possibilities of hazardous accidents occurring in power reactors located in urban areas are discussed. (D.C.C.)

49540 DYNAMIC CHARACTERISTICS OF THE TURBINE AND DUMP CONTROL SYSTEMS IN THE GUNDREMMINGEN NUCLEAR POWER STATION. Timm, M. Energ. Tech., 20: 301-8(Oct. 1968). (In German).

Extensive dynamic tests have been carried out on this boiling water reactor to supplement design calculations and improve the original setting of the control system. They included step loading tests and a frequency analysis in which a variable-frequency voltage was injected at the controller set point, producing 30 MW swings at 0.92 Hz. Emergency turbine shut-down and reactor scram were investigated in detail and graphs of important system variables are reproduced. (UKAEA Info. Bull.)

Power Reactor Development

Refer also to abstracts 47815, 48315, 48573, 49609, 49614–49620, 49624–49631, 49635–49638, 49640, 49641, and 49644–49647.

49541 (ANL-7410) REACTOR PHYSICS DIVISION ANNUAL REPORT, JULY 1, 1967–JUNE 30, 1968. (Argonne National Lab., Ill.). Jan. 1969. Contract W-31-109-eng-38. 445p. Dep. CFSTI.

Sections of the report, for which separate abstracts are prepared, include: Fission Properties and Cross Section Data; Thermal Reactor Physics; Fast Reactor Physics; Fast Reactor Safety; Experimental Techniques and Facilities; and Reactor Computation Methods and Theory. (86 references) (M.L.S.)

For abstracts of individual sections see: 49315, 49572, 49580–49582, and 49651.

49542 (NSJ-tr-151) ANALYSIS AND EVALUATION OF A D_2O MODERATED CO_2 COOLED POWER REACTOR. Mochizuki, Hiroji. Translated from Fapig (Tokyo), 46: 98-107(1967). 26p. Dep. CFSTI (U. S. Sales Only).

A CO_2-cooled D_2O power reactor was analytically studied for optimum design. The parameters determining the performance of the type of reactor, are analyzed. Although the analysis was confined to reactor characteristics in normal operation, the results of analysis showed that the gas-cooled D_2O reactor has superior properties as an advanced converter reactor. (auth)

49543 (ORNL-4295) NUCLEAR ENERGY CENTERS: THE PROBLEMS OF IMPLEMENTATION. Ritchey, J. A. (Oak Ridge National Lab., Tenn.). Aug. 1969. Contract W-7405-eng-26. 18p. Dep. CFSTI.

Research and industrial complexes utilizing nuclear reactors are analyzed. Problems concerning the development and operation of these complexes are described. Influencing factors related to the development and operation of nuclear complexes include: project goals, politics, economics, organization and management, type of complex, and construction and startup. 20 references. (D.C.C.)

49544 THE REORGANIZATION OF THE NUCLEAR INDUSTRY IN THE UKAEA AND THE EXPORT MARKET. Com. Naz. Energ. Nucl., Notiz., 15: No. 7, 62-9(July 1969). (In Italian).

The present situation of the nuclear industry in Great Britain and its present prospects are reviewed. The recent agreement between the UKAEA and the Greek Government's Electric Power Agency for the supply to Greece of an SGHWR Plant is discussed. (auth)

49545 ATOMIC ENERGY WHITE PAPER, THE 1969 EDITION. Genshiryoku Hakusho, No. 13, 205p.(Aug. 1969). (In Japanese).

Atomic energy activities in Japan during 1968 are described. Topics described include: development of power reactors, the start of construction of the first nuclear-powered ship "Mutsu," advances in the fields of uranium enrichment, food irradiation, nuclear fusion, and the advanced international cooperation, especially between the U. S., U. K., and Japan. (NSA of Japan)

49546 PEBBLE BED REACTOR. Bedenig, Dieter. Bild Wiss., 6: 616-25(July 1969). (In German).

The characteristics of the pebble bed type reactor are presented. A comprehensive survey of future developments is presented. (auth)

Kinetics and Dynamics

Refer also to abstract 49385.

49547 (AEEW-R-560) EXPERIMENTAL PHYSICS STUDIES OF STEAM-COOLED FAST REACTOR LATTICES. Arnold, M. J.; Fox, W. N.; George, C. F.; Richmond, R.; Aldous, A. C.; Burholt, G. D.; Skillings, D. J.; Wheeler, R. C. (Atomic Energy Establishment, Winfrith (England)). Apr. 1969. 183p. Dep. CFSTI (U. S. Sales Only). UK 25s. 0d.

As part of a general investigation of fast reactors, an assessment study of a steam cooled fast reactor system has been carried out at A.E.E., Winfrith. A programme of experimental measurements in the reactor DIMPLE in support of this assessment study provided data on the k-infinity and breeding gain in lattices of simulated typical steam cooled reactor composition. A mixed-critical reactor arrangement was used in which a small section of fast reactor lattice was made critical by surrounding it with a thermal lattice together with a suitable neutron filtering zone. Measurements were made of k-infinity and the most important capture and fission reaction rates (^{238}U, ^{239}Pu, ^{235}U). The results indicate that the data set in current use for this assessment significantly underestimates the ^{239}Pu capture rates. The limits of applicability of the data set are assessed. 34 references. (auth) (UK)

49548 (ANL-Trans-771) STUDY OF THE CONTROL OF A FAST-REACTOR NUCLEAR POWER PLANT ON A HYBRID COMPUTER. Chamboredon, C.; Hery, M.; Marion, B. Translated for Argonne National Lab., Ill., from 5th International Congress of AICA, Lausanne, Switzerland. 14p. (CONF-670835-2). Dep. CFSTI.

The use of a hybrid computer to simulate the dynamics of a liquid Na cooled fast power reactor for control purposes is described. Heat exchanger and boiler circuits are represented by heat transfer equations. The chronology of calculations is described. (D.C.C.)

49549 (BAW-1330) 1000-MWe LMFBR FOLLOW-ON STUDY. Control Study. Burris, J. R.; Trost, R. J. (Babcock and Wilcox Co., Lynchburg, Va. Power Generation Div.). Oct. 1968. Contract 31-109-38-1998. 156p. Dep. CFSTI.

For Argonne National Lab., Ill.

A thermal, hydraulic, and control analysis performed on a 1000 MW(e), Na-cooled fast breeder reactor plant is presented. The transient and steady-state analyses cover the reactor fuel, the reactor coolant system, the intermediate coolant system, the IHXs, the steam generators, and the reheaters. A digital computer was utilized for the whole plant analyses at steady state, while the transient and the control response analyses were performed on analog computers. The dynamic study of the plant was accomplished by simulating the reactor and the intermediate systems on two analog computers. The neutron kinetics of the reactor are simulated by a point kinetics equation with one group of delayed neutrons. All heat transfer processes are described by conventional heat transfer equations. These model equations do account for variable values of the product UA. The overall plant model considers all significant time delays, including the delay

effects of Na mixing, Na flow, valve actions, and sensor devices. The model delays are both constant and variable, depending on the particular application. The control philosophy is that of reactor following turbine generator megawatt demand. All controls are of the proportional plus integral type and monitor either system temperatures, system flows, or neutron flux. Control action is taken through control rod insertion, reactor and intermediate pump speed changes, intermediate bypass valve stroke changes, and reheater valve stroke changes. The results demonstrate that the chosen plant control arrangement responds adequately to typical changes in the turbine generator megawatt demand. The plant is limited to 2%/min load ramp and 5% step changes in load. The rates of change in the megawatt demand ranged from 1 to 2%/min load ramps and from 5 to 40% step changes. In all cases the plant responded well and showed control stability. (auth)

49550 (WAPD-TM-762) SOLID MECHANICS WITH APPLICATIONS TO PRESSURIZED WATER REACTORS. Pfennigwerth, P. L. (Bettis Atomic Power Lab., Pittsburgh, Pa.). Sept. 1969. Contract AT(11-1)-Gen-14. 113p. Dep. CFSTI.

Solid mechanics topics related to pressurized-water reactors are discussed. Topics discussed are deformation of continuous media, stress relationships, material behavior, elasticity, plasticity, creep, matrix analysis of structures, and stability problems. 19 references. (auth)

49551 FAST POWER REACTOR OPTIMIZATION BY BASE POINT METHOD. Kazachkovskii, O. D.; Kirillov, E. V.; Nikol'skii, R. V.; Potamanov, V. I. At. Energ. (USSR), 27: 183-6 (Sept. 1969). (In Russian).

Optimum design parameters for fast power reactor cores are calculated by the base point method. Fuel costs are assumed to be the minimizing function. 6 references. (auth)

49552 MEASUREMENT, SIMULATION, AND CONTROL OF FLUCTUATING PHENOMENA IN NUCLEAR REACTOR SYSTEMS. Kemeny, Leslie G. (New South Wales Univ., Kensington). Elec. Eng. Trans., Inst. Eng., Aust., EE5: 13-25(Mar. 1969).

The measurement of nuclear reactor system time constants by time-series correlation and spectral analysis techniques is discussed. Methods for data acquisition and statistical analysis are outlined. Results of measurements performed on zero energy and power reactor systems are presented. The technique is compared with other forms of dynamic diagnostic experimentation. The statistical experiments are simulated on a Hybrid Computer and the results related to the theoretical model and the experimental measurements. The generation of suitable pseudo-random pulse trains and the programming of the computer are discussed in detail. Mathematical models are synthesized and numerical algorithms formulated for the control of fluctuating phenomena in nuclear reactor systems. (auth) (Australia)

Control Systems

49553 (CEND-3932-1) OPTIMUM SPATIAL FLUX CONTROL PROJECT: PHASE I. CEXE: A THREE-DIMENSIONAL NODAL METHOD FOR ANALYSIS OF XENON OSCILLATIONS AND CONTROL. Kern, Richard; Wright, David C.; Coppersmith, W. Carlton; Rosztoczy, Zoltan R. (Combustion Engineering, Inc., Windsor, Conn. Nuclear Power Dept.). May 31, 1969. Contract AT(30-1)-3932. 132p. Dep. CFSTI.

A simple three-dimensional calculational method that can be used to study xenon oscillations and control in power reactors is described. The CEXE code is based on modified one-group theory for the calculation of the neutron source distribution. The mathematical model, application, and logistics of CEXE are presented. Another code, INCEXE, that was written to prepare a portion of the CEXE input, is described. Both codes are written in FORTRAN IV for the IBM 360/65. (H.D.R.)

49554 (CEND-3932-2) OPTIMUM SPATIAL FLUX CONTROL PROJECT: PHASE II. XENON OSCILLATION STUDIES FOR THE PICKERING REACTOR. Kern, Richard; Bonaca, Mario; Rosztoczy, Zoltan R.; Coppersmith, W. Carlton (Combustion Engineering, Inc., Windsor, Conn. Nuclear Power Dept.). May 31, 1969. Contract AT(30-1)-3932. 72p. Dep. CFSTI.

The comparisons of CEXE results with those of diffusion theory, for the one- and two-dimensional transient problems and the three-dimensional equilibrium calculation for the Pickering Reactor, show that good agreement exists between the two methods provided that the nodal source convergence criterion in CEXE is equivalent to the convergence criterion in the diffusion theory calculation. This agreement is independent of the size of the perturbation as well as the length of the time step used in the problem. The one-dimensional transient results for the Pickering Reactor indicate that the axial mode is stable and that large perturbations (such as the temporary removal of an adjuster rod bank) and small perturbations (such as refueling one-half of one channel) result in convergent oscillations. The two-dimensional transient analysis for Pickering in which the excitation of the azimuthal mode by refueling one fuel channel was investigated demonstrates that this mode is unstable and will lead to rapidly divergent oscillations if no control action is taken. The CEXE analysis of the three-dimensional xenon oscillation for Pickering which was induced by refueling 60% of one fuel channel showed that the oscillation was unstable and that the azimuthal mode prevailed over the axial mode with both the axial and azimuthal modes being more stable in the three-dimensional analysis than the one- and two-dimensional analyses of an equivalent perturbation had indicated. The agreement found between CEXE and diffusion theory calculations recommends the code as a practical design tool. (H.D.R.)

49555 APPLICATIONS OF MODERN CONTROL THEORY TO NUCLEAR REACTOR SYSTEMS. Sage, Andrew P.; Melsa, James L. (Southern Methodist Univ., Dallas). Elec. Eng. Trans., Inst. Eng., Aust., EE5: 61-72(Mar. 1969).

A survey is presented of the application of analytical and computational techniques of modern control theory for the estimation, identification and control of nuclear reactor systems. Included are discussions of models for nuclear reactors, optimum reactor startup, the maximum principle, quasilinearization trajectory computation, gradient trajectory computation, closed loop startup control, steady state control by state variable feedback, parameter and state estimation, and adaptive reactor control. A total of nine examples illustrate specific applications of the theory of nuclear reactor systems. (auth) (Australia)

49556 PROMPT RESPONSE TO LOAD CHANGE BY EXTRACTION FLOW CONTROL. Hattori, Sadao (Chubu Electrical Power Co., Japan); Aoki, Hideto; Shinmura, Akira. Nippon Genshiryoku Gakkaishi, 11: 532-8(1969). (In Japanese).

The possibility of obtaining prompt load response in narrow range of BWR plants is analyzed. The load response characteristics of BWR plants by means of extraction flow variation are described. A decrease of the extraction flow was found to cause the plant power to increase through the following three processes: steam flow increase in the turbine; reactivity increase by reactor pressure rise; and reactivity increase by reactor feed water temperature drop. (auth)

Shielding

Refer also to abstract 47675.

Cooling Systems

Refer also to abstracts 47696, 47878, and 47879.

49557 (RD/B/N-1418) EXPERIMENTAL OBSERVATIONS OF VAPOUR BUBBLE GROWTH IN VARIOUS CONSTRAINED GEOMETRIES. Board, S. J. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). July 1969. 28p. (FRPC/RSWP/P-(69)189). Dep. CFSTI (U. S. Sales Only).

The growth of vapor bubbles in water at constant uniform superheat in various constrained geometries was observed by high speed photography. Vapor slug growth in tubes was found to be consistent with the assumption of an evaporating liquid film on the walls. Bubble growth in a cluster of 12 simulated fast reactor fuel pins was also recorded; by comparison with growth in an unconstrained geometry it was shown that a liquid film adheres to the fuel pins. The shape of the growing bubble was found to be affected by the presence of the pins only at low growth rates. (auth)(UK)

49558 (STI/PUB-21/34) RECURRING INSPECTION OF NUCLEAR REACTOR STEEL PRESSURE VESSELS (1960-1966). Bibliographical Series No. 34. (International Atomic Energy Agency, Vienna (Austria)). 1968. 214p. IAEA $5.50. Dep.

The bibliography includes 918 references to the literature published from 1960 to 1966, divided into nine chapters according to subject matter. The main bibliographical source was Nuclear Science Abstracts; other sources were: Applied Mechanics Review; British Welding Journal; Welding Journal; Science Abstracts, Section A: Physics Abstracts; Proceedings of the Royal Society for Experimental Stress Analysis; and Reactor Materials and Metallurgical Abstracts. Names of the first authors or organizations are arranged in alphabetical order. The abstracts of papers

by individual authors are followed by those of corporate authors. An introduction, an author index and a keyword index are also given. (auth)

49559 WATER MODERATED AND COOLED NUCLEAR REACTOR POWER PLANT. Winkler, Franz (to Siemens Aktiengesellschaft). U. S. Patent 3,467,577. Priority date Aug. 13, 1965, Germany.

A heterogeneous nuclear power reactor power plant moderated and cooled by water at supercritical temperature and pressure includes a coolant loop for supplying feed water through the reactor to convert it to live steam and a heat exchanger of the indirect type connected to the feed water supply means upstream of the reactor. Also provided are means for conducting a portion of the live steam from the reactor to the heat exchanger for preheating the feed water passing through the heat exchanger. A conduit connected between the heat exchanger and the feed water supply means is located upstream of the heat exchanger. A pump connected in the conduit returns condensate through the conduit from the heat exchanger to the feed water supply means for preheating the feed water in the supply means. (Offic. Gaz.)

49560 REACTORS. Kornbichler, Heinz; Ullrich, Walter; Mainka, Alfred; Lohse, Karl-Heinz (to Licentia Patent-Verwaltungs-GmbH). U. S. Patent 3,467,578. Priority date July 23, 1965, Germany.

In a boiling water reactor pressure vessel of the type employing forced circulation of a cooling medium and enclosing a core and an annular backflow space surrounding the core, at least one forced circulation pump including a rotary impeller is located in the lower portion of the backflow space within the pressure vessel. The impeller is arranged to have a vertical axis of rotation for imparting a downward vertical movement to the liquid medium in the backflow space. (Offic. Gaz.)

49561 PROCESS FOR THE PREVENTION OR REDUCTION OF CARBON DEPOSITS ON METAL SURFACES IN A NUCLEAR REACTOR. Karcher, W. (to EURATOM). Canadian Patent 812,249. May 6, 1969. Priority date Mar. 9, 1967, Netherlands.

Carbon deposits on the metal surfaces of a high temperature gas cooled reactor may be reduced by the addition of a volatile silane (triethylsilane) to the coolant gas before it passes through the heat exchanger. The quantity added should not exceed 0.1 g of the silicon compound per litre of cooling gas. The addition of this substance is only effected when sampling indicates a considerable concentration of CO and H in the coolant gas circuit. (F.S.A.)

49562 DEVELOPING A UNIQUE GAS SEAL FOR PRESSURE VESSELS. Tisdale, D. E. Engineer, 114: 35-7(Sept. 1969).

A sliding seal is described which forms an impermeable barrier through the insulation of a reactor pressure vessel. The seal provides gas by-passing the heating surface. The seal, which terminates in a segmented ring next to the hot face of the liner insulation, withstands temperatures of 400°C on the hot surface, has a liner temperature of 60°C, and has a pressure difference of 5 lbf/in^2 through 2 in. insulation. Problems of design, handling, and installation are discussed. (UK)

Fuels

Refer also to abstract 47694 and 48351.

49563 (CONF-681219-2) FUEL CYCLES FOR ADVANCED CONVERTERS. Conti, F.; Graziani, G.; Kind, A.; Rinaldini, C.; Zanantoni, C. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). [1968]. 37p. (In Italian). Dep. CFSTI (U. S. Sales Only).

From 10th International Nuclear Energy Conference, Milan, Italy.

Various fuel cycles for heavy water moderated reactors and high temperature gas cooled reactors are considered. Fissile isotopes production and consumption and fuel cycle costs are analyzed. Several fuel element geometries and cycle schemes are considered and optimized. Moderation ratio, burn-up and specific power are chosen to minimize the fuel cycle cost. Uranium consumption and Pu production are reported as a function of burn-up for optimized high temperature reactors and heavy water reactors. The data are compared with values typical of pressurized light water reactors. 12 references. (auth)

49564 (GA-9639) GAS-COOLED FAST BREEDER REACTOR. Quarterly Progress Report, May 1-July 31, 1969. (Gulf General Atomic, Inc., San Diego, Calif.). Aug. 30, 1969. Contract AT(04-3)-167. 121p. Dep. CFSTI.

KRYPTON—diffusion of, effects of helium pressure on
NEUTRONS, FAST—effects on uranium oxide (UO_2) and plutonium oxide (PuO_2)–uranium oxide (UO_2) sealed can type fuel elements
—effects on voids in Type 304 and Type 316 stainless steel, effects of annealing on
NEUTRONS, THERMAL—effects on uranium oxide (UO_2) and plutonium oxide (PuO_2)–uranium oxide (UO_2) sealed can type fuel elements
PLUTONIUM OXIDES PuO_2—radiation testing of gas cooled fast breeder fuels of
REACTOR EXPERIMENTAL FACILITIES—design parameters of available gas cooled fast reactor fuel element development, comparison of
REACTOR FUEL ELEMENTS—radiation effects on uranium oxide (UO_2) and plutonium oxide (PuO_2)–uranium oxide (UO_2) sealed can type, analysis of fast and thermal neutron
—radiation testing of uranium oxide (UO_2) and plutonium oxide (PuO_2)–uranium oxide (UO_2), for gas cooled fast breeder
REACTORS, BREEDER—core development for gas cooled fast, summary from May to July 1969 of
REACTORS, FAST—core development for gas cooled breeder, summary from May to July 1969 of
REACTORS, GAS-COOLED—core development for fast breeder, summary from May to July 1969 of
STAINLESS STEEL—radiation effects on voids in Type 304 and Type 316, relations of annealing on
URANIUM OXIDES UO_2—radiation testing of gas cooled fast breeder fuels of (D.C.C.)

49565 (LA-4187) CALCULATIONAL MODELING EFFECTS ON FAST BREEDER FUEL CYCLE ANALYSIS. Hirons, Thomas J.; O'Dell, R. Douglas (Los Alamos Scientific Lab., N. Mex.). Apr. 1969. Contract W-7405-eng-36. 16p. Dep. CFSTI.

The economic analysis of a large fast breeder is dependent on fuel-cycle parameters such as fuel discharge rate and breeding ratio. The variation of fuel-cycle parameters with several burnup-model characteristics is studied. These characteristics are the amount of region detail used in describing the reactor, the initial fissile content of the reactor, the maintenance of criticality during the burnup step, the distribution of the control poison during the burnup step, and the flux or power shift over the reactor lifetime. Each of these model characteristics is analyzed in detail for its effect on the burnup history of the reactor. The mass balances obtained from several of the burnup studies are input to a reactor economics code to determine the economic effects of changes in the model characteristics. The greatest effect on the fuel-cycle analysis is produced by the treatment of the relative flux shift between burnup intervals. The assumption of constant flux produces errors in ^{239}Pu discharge of up to 7% in the axial blankets. When the charge-discharge data are input to the economics code, the assumption of constant flux produces negligible differences in power costs, but results in an error of about 5% in the net yield of fissile isotopes per MW(e)-yr. 6 references. (auth)

49566 (NYO-3250-39) REFERENCE CORE DESIGN FOR THE CONNECTICUT YANKEE ATOMIC POWER COMPANY HADDAM CONNECTICUT REACTOR. Coen, I. H. (comp. and ed.) (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.). Apr. 1967. Contract AT(30-1)-3250. 77p. (WCAP-2906). Dep. CFSTI.

The reference design parameters for the pressurized light water moderated and cooled reactor core are presented. Pertinent mechanical, thermal and hydraulic, nuclear design data, and ground rules affecting the selection of the design data are presented. Considerations affecting the selection of the design concepts, selection of core materials and specific values of design parameters are also given. (auth)

49567 (ORNL-TM-2685) INHERENT NEUTRON SOURCE IN MSRE WITH CLEAN ^{233}U FUEL. Steffy, R. C. Jr. (Oak Ridge National Lab., Tenn.). Aug. 10, 1969. 22p. Dep. CFSTI.

After about three years of nuclear operation, the MSRE fuel, enriched ^{235}U, was replaced with a ^{233}U fuel mixture. In this new mixture there are quantities of ^{232}U, ^{233}U, and ^{234}U. Each of these, along with the ^{232}U decay chain, is a strong α emitter and interacts with F, Be, and Li to produce neutrons. This neutron source is time-dependent because of the buildup of ^{232}U daughters, and at the time of reaching criticality with the ^{233}U fuel, the neutron source in the MSRE core was about 4×10^8 neutron/sec, primarily from the reactions $^9Be(\alpha,n)^{12}C$ and $^{19}F(\alpha,n)^{22}Na$. Alpha-n reactions with Li will produce $< 3 \times 10^8$ neutrons/sec. Spontaneous fission will produce $< 10^2$ neutrons/sec. 11 references. (auth)

49568 CYCLE OF Th–U–Pu SYSTEM ON FAST BREEDER. 2. Hayasaka, Hideo; Yamamoto, Norio (Tohoku Univ., Sendai). Nippon Genshiryoku Gakkaishi, 11: 476-81(Aug. 1969). (In Japanese).

The burn-up of Th–U–Pu system fuel in a fast breeder reactor has been analytically obtained as a solution to the problem of perturbation of a time-dependent depression matrix. In this approach, the addition of fertile material to the system and the extraction of spent fuel out of the breeding system produce a feedback effect on the depression matrix in the form of restrictions imposed upon the concentration of the nuclear species as well as upon the power output of the system. The breeding system is regarded as a closed loop of automatic control with time-variable-parameters (T.V.P. system). The system of perturbation is expressed by vector Volterra equation, and its solution obtained as a Neumann series with iterated kernels. The variations of perturbation can be expanded into polynominals of time. The coefficients for the expansion are determined by the conditions of restriction applying on the concentration of the nuclear species. The nuclear species, the rate of supply of the fertile materials, and the extraction of the fuel at any time are calculated. (auth) (NSA of Japan)

Operation and Economics

49569 STARTUP OF SEFOR MARKS NEW STAGE IN LMFBR DEVELOPMENT. Nucl. News, 12: No. 6, 28-9; 30 (June 1969).

A review of the development and startup programs for the SEFOR is presented. Experimental program tests are described. (D.C.C.)

49570 HOW TO STAFF AND TRAIN FOR NUCLEAR POWER. Duvall, F. C. (NUS Corp., Washington, D. C.). Elec. Light Power (Boston), 47: 128-31(July 1969).

A training schedule for operators and personnel of nuclear power reactors is described. Training requirements are analyzed. (D.C.C.)

49571 MSRE INTO MSBR. THE HOPES FOR ORNL'S MOLTEN SALT REACTOR PROGRAM. Rosenthal, Murray W. Oak Ridge Nat. Lab. Rev., 2: No. 2, 1-13(Fall 1968).

A brief review of the development and operation of the MSRE is presented. Design parameters are listed. Maintenance procedures and operating experiences are described. The design parameters for a MSBR are discussed. (D.C.C.)

Safety and Siting

Refer also to abstracts 47452, 47639, and 47640.

49572 (ANL-7410, pp 229-337' FAST REACTOR SAFETY. (Argonne National Lab., Ill.).

CESIUM — surface tension for liquid, tabular summary of constants for
— critical points for liquid, tabulation of data on
EXPERIMENTAL BREEDER REACTOR-II — fuel elements for, high power level TREAT tests on unbonded
— fuel elements for, calculations of results of thresholds for swelling of
HODOSCOPES — readout system for TREAT fast neutron, description and schematic for digital photographic
IN-PILE LOOPS — fabrication of TREAT integral sodium, standards and quality control for
IRON — equations of state for
LITHIUM — surface tension for liquid, tabular summary of constants for
— critical points for liquid tabulation of data on
POTASSIUM — surface tension for liquid, tabular summary of constants for
— critical points for liquid tabulation of data on
REACTOR CONTAINMENT SYSTEMS — leakage rates from, required temperature sensor distribution for determining
REACTOR FUEL ELEMENTS — testing of unbonded EBR-2, results of high power level TREAT
— failure of fast, description of equipment for high speed photographic analysis of
— testing of fast, TREAT design modifications to allow
— cladding for fast, analysis of temperature transient-induced failures of
— cladding for fast, analysis of accelerated creep of
— testing of fast, use of thermal reactor for
REACTOR SAFETY — sodium boiling transients for fast, calculated temperature and mass flow rate profiles for
— sodium boiling transients for fast, calculated feedback reactivities and void coefficients for
— analysis of hypothetical maximum energy release accidents for zoned fast, method for treatment of discontinuous derivatives at interfaces for
REACTOR SAFETY EXPERIMENTS — hodoscope for TREAT, description and schematic for digital photographic readout system for fast neutron
— sodium loop for TREAT, standards, quality control, and fabrication of integral
— experiments irradiated in TREAT, description of shipping cask for
— fuel element testing in TREAT, design changes to allow fast reactor
— loop for TREAT, calculation of expansion of supercritical sodium vapor released in test
REACTORS — stability criteria for large, analysis of Liapunov's method for determining
REACTORS, FAST — fuel elements for, description of equipment for high speed photographic analysis of failed
— sodium boiling transients in carbide fueled, calculated temperature and mass flow rate profiles for
— sodium boiling transients in carbide fueled, calculated feedback reactivities and void coefficients for
— sodium void effects in, comparison of theoretical and experimental analyses of
— accidents in zoned, method for treatment of discontinuous derivatives at interfaces for hypothetical maximum energy release
— accidents in, phenomenological description of events during hypothetical
— fuel elements for, analysis of temperature transient-induced cladding failure for
— fuel elements for, use of thermal reactor for testing of
— excursions in, calculation of time distribution of reactivity in super-prompt critical
REACTORS, LIQUID METAL COOLED — sodium boiling transients in carbide fueled, calculated temperature and mass flow rate profiles for
— sodium boiling transients in carbide fueled, calculated feedback reactivities and void coefficients for
— sodium void effects in, comparison of theoretical and experimental analyses of
RUBIDIUM — surface tension for liquid, tabular summary of constants for
— critical points for liquid, tabulation of data on
SHIELDED CONTAINERS — design for TREAT irradiated experiments
SODIUM — vapor releases in TREAT sodium loop, calculation of expansion of supercritical
— surface tension for liquid, tabular summary of constants for
— critical points for liquid, tabulation of data on
STEEL — equations of state for
XENON — surface tension for liquid, tabular summary of constants for
— critical points for liquid, tabulation of data on (M.L.S.)

49573 (NYO-3986-1(Vol.2)) PHASE I. NEW PROTECTIVE SYSTEM DESIGN TECHNIQUES FOR APPLICATION IN NUCLEAR REACTOR PLANTS. VOLUME II. Schultz, M. A.; Geisler, G. C. (Pennsylvania State Univ., University Park. Dept. of Nuclear Engineering). Mar. 31, 1969. Contract AT(30-1)-3986. 430p. Dep. CFSTI.

Abstracts of references on techniques to assure the reliability of components and systems in reactor protective systems are presented. (H.D.R.)

49574 INTERNATIONAL SAFEGUARDS OF NONMILITARY NUCLEAR TECHNOLOGY. I. THE RAPID GROWTH OF NUCLEAR TECHNOLOGY: IMPLICATIONS FOR NUCLEAR SAFEGUARDS. Taylor, Theodore B. IRT (Int. Res. Technol.) Nucl. J., 1: No. 1, 1-51(Jan. 1969).

Requirements for an international system of nuclear safeguards are described. Military and nonmilitary applications of nuclear technology are reviewed. Predicted production figures for enriched ^{235}U and Pu are listed. (23 references) (D.C.C.)

49575 INTERNATIONAL SAFEGUARDS OF NONMILITARY NUCLEAR TECHNOLOGY. III. OBJECTIVES AND CONSTRAINTS RELATED TO NUCLEAR SAFEGUARDS. Taylor, Theodore B. IRT (Int. Res. Technol.) Nucl. J., 1: No. 3, 1-25(Mar. 1969).

Authorized objectives and constraints related to an international system of nuclear safeguards are described. Restrictions are discussed, and proposed effectiveness is analyzed. (D.C.C.)

49576 INTERNATIONAL SAFEGUARDS OF NONMILITARY NUCLEAR TECHNOLOGY. II. THE NEED FOR NUCLEAR SAFEGUARDS. Taylor, Theodore B. IRT (Int. Res. Technol.) Nucl. J., 1: No. 2, 1-15(Feb. 1969).

The need for an international system of nuclear safeguards is reviewed. An outline of feasible nuclear threats from a lack of sufficient safeguards is presented. Several examples of nuclear threats are described in detail. (4 references) (D.C.C.)

49577 THE IMPACT OF NUCLEAR TECHNOLOGY ON THE MIDDLE EAST. Van Cleave, William R. IRT (Int. Res. Technol.) Nucl. J., 1: No. 2, 16-34(Feb. 1969).

The development of nuclear technology in Egypt and Israel is reviewed. The effects of nuclear technology on military defense are described. Defense-related non-nuclear technology in the Middle East is also discussed. (D.C.C.)

49578 EARTHQUAKES AND NUCLEAR POWER. Lyon, Richard N. Oak Ridge Nat. Lab. Rev., 2: No. 2, 29-40(Fall 1968).

Earthquake hazards in the U. S. are described. Design requirements for nuclear power reactors that will withstand earthquake forces are presented. Phenomena related to earthquakes are analyzed. (D.C.C.)

49579 LET'S PUT PERSPECTIVE IN NUCLEAR PLANT SITING. Roddis, Louis H. Jr. (Consolidated Edison Co., New York). Elec. World, 171: No. 15, 78-80(Apr. 14, 1969).

Objectives in the siting of nuclear power plants are described. The effects of power reactors on the environment are analyzed. Safety precautions are discussed. Public demands on reactor safety and power plant appearance are described. (D.C.C.)

Power Conversion Systems

Refer also to abstract 47669.

Research and Test Reactors

Refer also to abstracts 47598, 47600, 48059, 49275, 49398, and 49541.

49580 (ANL-7410, pp 47-72) THERMAL REACTOR PHYSICS. (Argonne National Lab., Ill.).

ARGONNE ADVANCED RESEARCH REACTOR — core for, effective neutron multiplication factor calculations for HFIR-type
— operation of, calculations of xenon buildup after power setback from equilibrium
— core for, calculated group-averaged eta values and energy distributions in HFIR-type
— core for, calculated thermal neutron fluxes at midplane in HFIR-type
— thermal column for, calculated effects of core size and loadings on thermal fluxes in internal
COPPER — cadmium ratio measurements in EBWR at 40 and 70 MW
CRITICAL ASSEMBLIES — cores for, revised conversion ratios for 3% and 5% enriched uranium oxide (UO_2) fueled
EXPERIMENTAL BOILING WATER REACTOR — core for, description and loading diagrams for plutonium recycle
— cores for, comparison of activation distributions in plutonium fueled and uranium fueled
— fuel elements for, results of post-shutdown γ scanning of plutonium recycle
GOLD — cadmium ratio measurements in EBWR at 40 and 70 MW
LUTETIUM ISOTOPES Lu-176 — cadmium ratio measurements in EBWR at 40 and 70 MW
LUTETIUM ISOTOPES Lu-177 — cadmium ratio measurements in EBWR at 40 and 70 MW
NEUTRONS — activation ratios for uranium oxide (UO_2) fueled-water moderated assemblies, modified equations for sub-cadmium and thermal
— multiplication factors in HFIR-type cores, calculation for AARR of
— eta values for AARR HFIR-type core, calculations of group averaged
— energy distributions in AARR HFIR-type core, calculations of group-averaged
— fluxes in AARR internal thermal column, calculated effects of core size and loading on
REACTOR FUEL ELEMENTS — gamma scanning of EBWR plutonium recycle, results of post-shutdown
XENON — buildup in AARR, calculations of effects of power setback on (M.L.S.)

49581 (ANL-7410, pp 73-227) FAST REACTOR PHYSICS. (Argonne National Lab., Ill.).

CRITICAL ASSEMBLIES — core for Assembly 6 of ZPR-6, material compositions of 4000 liter uranium oxide (UO_2) fast
— neutron fission distributions in fast Assembly 6 ZPR-6, uranium-235
— neutron capture distributions as a function of height in Assembly 6 ZPR-6, measurement of uranium-238 spatial
— cores for Assemblies 19, 21, 22, and 24 of ZPR-9, dimensions and atom densities for fast
— neutron fluxes for Assemblies 19, 21, 22, and 24 of ZPR-9, tabulation of measured and calculated real and adjoint
— reactivity worths for Assemblies 19, 21, 22, and 24 of ZPR-9, tabulation of measured and calculated central
— neutron fission rate measurements in Assemblies 19, 21, and 22 of ZPR-9, radial uranium-235
— physics parameters for Assemblies 12, 13, 14, 16, and 17 of ZPR-9
— reactivity worths in Assemblies 12, 13, 14, 16, and 17 of ZPR-9, comparison of measured and calculated Doppler and central
— core for Assembly 18 of zoned fast ZPR-9, atom densities and critical parameters for
— Doppler reactivity measurements in zoned fast Assembly 18 of ZPR-9, effects of temperature on
— core for zoned fast Assembly 18 of ZPR-9, calculated direct and adjoint fluxes and spectra for
— Doppler effect measurements in Assembly 23 of ZPR-9, comparison of calculated values with
— core for Assembly 6 of ZPR-6, sodium void coefficient as a function of position in 4000-liter uranium oxide (UO_2)
— core for Assembly 5 of ZPR-6, measurement of gap reactivity worths in 2600-liter uranium carbide (UC)
— core for Assembly 6 of ZPR-6, effects of drawer loading pattern on reactivity of
— neutron fission rate measurements in Assembly 6 of ZPR-6, uranium-235 and uranium-238
— reactivity worths measurements of uranium-235, uranium-238, iron and nickel in Assembly 6 of ZPR-6, effects of sample thickness on
— neutron fission and capture rates in Assembly 6 of ZPR-6, comparison of measured and calculated
— neutron spectrum in Assembly 6 of ZPR-6, use of proton-recoil proportional counter for in-core measurements of
— neutron capture-to-fission ratios for uranium-235 and plutonium-239 in Assembly 24 of ZPR-9, use of null-reactivity and reaction-rate techniques for measurement of
— neutron capture-to-fission ratio measurements in Hi-C core of ZPR-7, use of lithium-6 as reference absorber for
— reactivity for Assembly 51 of ZPR-3, effects of geometry variations on discrete ordinates calculations of
— neutron fluxes in Assembly 52 of ZPR-3, calculated values for
EXPERIMENTAL BREEDER REACTOR-II — power coefficient for, effects of change from depleted uranium to stainless steel blanket on variations of
— reactivity coefficients for, tabulation for Runs 16, 24, 25, 26, 27, and 27A of
— physics analyses of, development of neutron cross section sets for
— fuel elements for, neutronics characteristics of Mark-II oxide test
IRON — reactivity worth measurements in ZPR-6 Assembly 6, effects of sample size on
LITHIUM ISOTOPES Li-6 — neutron absorbers of, capture-to-fission ratio measurements in Hi-C core of ZPR-7 using,
MOLYBDENUM — neutron capture cross sections for, comparison for fast reactor physics calculations of
NEPTUNIUM ISOTOPES Np-237 — production from uranium-236, effects of uranium-238 resonance shielding on,
NEUTRON CROSS SECTIONS — development for EBR-2 physics studies
NEUTRONS — fission distribution measurements in fast oxide Assembly 6 of ZPR-6
— capture distribution measurements as a function of height in fast oxide Assembly 6 of ZPR-6, uranium-238 spatial
— fluxes in Assemblies 19, 21, 22, and 24 of ZPR-9, tabulation of measured and calculated real and adjoint
— fission rate measurements in Assemblies 19, 21, and 22 of ZPR-9, uranium-235 radial
— fluxes for zoned fast core of ZPR-9 Assembly 18, calculated direct and adjoint
— spectra for zoned fast core for ZPR-9 Assembly 18, calculated direct and adjoint

—collision density in fast reactors, effects of elastic slowing down in Doppler region on
—collision densities in fast reactors, analyses of effects of resonances of moderating elements on
—fission rate measurements in ZPR-6 Assembly 6, uranium-235 and uranium-238
—fission rates in ZPR-6 Assembly 6, comparison of measured and calculated values for uranium-235 and uranium-238
—capture rates in ZPR-6 Assembly 6, comparison of measured and calculated values for uranium-235 and uranium-238
—spectra in ZPR-6 Assembly 6, use of proton-recoil proportional counter for in-core measurement of
—flux spectra in fast reactors, effects core diluents and multigroup cross section averaging on
—current spectra in fast reactors, effects of core diluents and multigroup cross section averaging on
—capture-to-fission ratios for uranium-235 and plutonium-239 in ZPR-9 Assembly 24, use of null-reactivity and reaction rates for measuring
NICKEL—reactivity worth measurements in ZPR-6 Assembly 6, effects of sample size on
RADIATION DETECTORS, PROPORTIONAL—neutron spectra measurements in ZPR-6 Assembly 6 using proton-recoil results of in-core
REACTIVITY—worths for Assemblies 19, 21, 22, and 24 of ZPR-9, tabulation of measured and calculated central
—worths in Assemblies 12, 13, 14, 16, and 17 of ZPR-9, comparison of measured and calculated Doppler and central
—Doppler measurements in zoned fast Assembly 18 of ZPR-9, temperature effects on
—Doppler effect measurements in Assembly 23 of ZPR-9, comparison of calculated values with
—Doppler coefficient for a sodium cooled stainless steel clad uranium dioxide (UO_2)–plutonium oxide (PuO_2) system, effects of statistical variances on
—Doppler coefficients for reactors, Monte Carlo calculation of multiregion hot-cold interference effects on
—sodium void coefficient for 4000-liter uranium oxide (UO_2) core for Assembly 6 of ZPR-6, measurement of effects of position in
—gap worth measurements in 2600-liter uranium carbide (UC) core of ZPR-6 Assembly 5
—core heterogeneity effects on, measurement in Assembly 6 of ZPR-6 of
—coefficients for EBR-2, tabulation of power-defect, temperature, and expansion and compaction
REACTOR FUEL ELEMENTS—physics characteristics of EBR-2 Mark-II oxide test
REACTORS—noise measurements in, summary descriptions of techniques for
REACTORS, FAST—neutron collision density in, effects of elastic slowing down in Doppler region on
—neutron collision density in, analysis of effects of resonances of moderating elements on
—cores for, use of five-group cross sections for calculating spatially dependent five-group fluxes for
—physics calculations for, comparison of various cross section sets for
URANIUM ISOTOPES U-235—reactivity worth measurements in ZPR-6 Assembly 6, effects of sample thickness on
—neutron fission cross sections for, comparison for fast reactor physics calculations of
URANIUM ISOTOPES U-236—neutron resonance absorption probability for, effects on reaction rate of
—neptunium-237 production from, effects of uranium-238 resonance shielding on
URANIUM ISOTOPES U-238—reactivity worth measurements in ZPR-6 Assembly 6, effects of sample size on
—neutron capture cross sections for, comparison for fast reactor physics calculations of (M.L.S.)

49582 (ANL-7410, pp 339-86) EXPERIMENTAL TECHNIQUES AND FACILITIES. (Argonne National Lab., Ill.).

COMPUTERS—modifications to ANL Reactor Physics Laboratory DDP-24 on-line data collection, description of
—electronics for proton-recoil proportional counting using, description of
CRITICAL ASSEMBLIES—neutron fission rate measurements in fast Assembly 5 of ZPR-6, use of solid state track recorders for
—control of, equations for time-optimal direct digital
DATA PROCESSING SYSTEMS—circuits for sampling-oscilloscope, ANL Reactor Physics Laboratory
—circuit diagrams for neutron spectra, preamplifier and discriminator
GAMMA SPECTROSCOPY—measurements for continuous in-core, Compton recoil continuum
NEUTRONS—fission rate measurements in ZPR-6 Assembly 5, results of solid state track recorder
—flux measurements in reactors, schematics for line-timer corrections for foil-counting data for
PHOTOMULTIPLIER TUBES—noise characteristics of, method for evaluating optimum
—timing characteristics of, method for evaluating
PREAMPLIFIERS—circuits for nuclear detector data-processing, noise-minimization input
PULSE DISCRIMINATORS—circuits for absolute coincidence, timing characteristics for
RADIATION DETECTORS—efficiency for single and coincidence counting, derivation of equations for
—line-timer automatic count corrections for, circuits for
RADIATION DETECTORS, DIELECTRIC TRACK—neutron fission rate measurements in ZPR-6 Assembly 5 using uranium foil–mica
RADIATION DETECTORS, PROPORTIONAL—neutron spectral measurements using proton-recoil, description of electronics for in-core
—finite-size effects in proton-recoil, spectral distortion from
REACTOR CONTROL SYSTEMS—dynamic characteristics of computerized, use of polarity-correlation algorithm for
REACTORS—core for, formulation of equations for use of Compton recoil continuum in continuous γ spectroscopy in
—neutron flux measurements in, schematics for line-timer corrections for foil-counting data for (M.L.S.)

49583 (BNWL-1029) HIGHLY ENRICHED U–Al, 0.95 WT PERCENT ENRICHED URANIUM, AND Li–Al TARGET SUPERCELL: PCTR EXPERIMENTS. Newman, Darrell F.; Mitsui, Hidehiko (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). July 1969. Contract AT(45-1)-1830. 94p. Dep. CFSTI.

A highly enriched Al–U, 0.95 wt % enriched uranium, and Al–Li target supercell lattice has been investigated in the Physical Constants Testing Reactor (PCTR). Neutron multiplication factors, utilization ratios, fast fission factors, resonance escape probabilities, and absorption ratios for ^{238}U and ^{6}Li relative to ^{235}U have been inferred from null reactivity experiments and measurements of the spatial distributions of neutron reaction rates. Microscopic neutronic parameters ($^{28}\rho$, $^{28}\delta$, $^{25}\delta$, δ^{6Li}, and C*) measured in the supercell lattice are reported. Experiments were performed at room temperature in a graphite moderated six-by-six cell array placed in the cavity of the PCTR, both with and without light water in the supercell lattice coolant channels. (18 references) (auth)

49584 (BNWL-1090) FAST FLUX TEST FACILITY QUARTERLY TECHNICAL REPORT, MARCH–MAY 1969. Astley, E. R. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). July 1969. Contract AT(45-1)-1830. 198p. Dep. CFSTI.

FAST FLUX TEST FACILITY—design and development during March to May 1969, summary of
FAST TEST REACTOR—design and development during March to May 1969, summary of
—containment system for, conceptual design of
—shielding analysis for
—fuel burnup in, management scheme for maximum
—fuel assemblies in, coolant pressure drop for
—core for, hot channel factors in
—safety analysis of
—cooling system for, analysis of performance of
—coolant for, radioisotope transport and deposition in liquid sodium
—materials for, development and fabrication of structural
—fuels for, processing and fabrication of
—fuel element cladding for, development and testing of
—fuel element inspection and testing for
—fuels for, irradiation testing of
REACTOR FUEL ELEMENTS—radiation testing of FTR driver pins
REACTOR FUELS—development of FTR mixed oxide, during March to May 1969
REACTOR SAFETY—accident analyses for FFTF
STAINLESS STEEL—mechanical properties of Type 304 and Type 316 tubes of
—radiation testing of FTR candidate fuel cladding and structural materials of (H.D.R.)

49585 (DUN-SA-107) MEASURED ENERGY DEPOSITION RATES FOR VARIOUS NONFISSIONABLE MATERIALS IN A NU-

CLEAR REACTOR ENVIRONMENT. Zimmerman, Paul J. (Douglas United Nuclear, Inc., Richland, Wash.). Aug. 20, 1969. Contract AT(45-1)-1857. 16p. (CONF-690910-3). Dep. CFSTI.

From Symposium on Developments in Irradiation Testing Technology, Sandusky, Ohio.

A calorimeter was developed which successfully measured the heat generation rate of many materials in a reactor test facility environment. Measurements were made for materials of sufficiently different properties so that it was possible to separate the heat generation by γ interactions from thermal neutron interactions. Gamma heating values ranged from 0.16 W/g for Ti to 0.25 W/g for Bi. Heat generation due to nuclear reactions of thermal neutrons was determined by subtracting the γ heating from the total measured values. The thermal neutron contribution varied from 0 to 9.78 W/g. Thermal neutron contributions exhibited a large dependence on geometry. Thermal neutron absorptions occurring in the vicinity of the material in question increase the γ flux significantly above that contributed by fissioning material in the surrounding lattices. (auth)

49586 (EUR-4230) SHIELDING EXPERIMENTS AT THE GEESTHACHT RESEARCH REACTOR. Annual Report, 1967. Bagge, E.; Fischer, E.; Buenemann, D.; Enginol, T. B.; Fiebig, R.; Frisius, F.; Harders, H.; Schnier, G. C. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Hamburg (West Germany)). Aug. 1969. 94p. (In German). Dep. CFSTI (U. S. Sales Only).

Optimization computations for a steel/water shielding for a high temperature gas-cooled reactor are described. Measured neutron profile widths in plane shields are compared with estimated widths and γ dose output calculations. Through variation of the group structure in the Restrab multigroup removal diffusion programme it is shown that the results depend upon the group structure. Computations on the same shielding structure are made with the Restrab (in three versions) NRN, MAC-RAD and COMPRASH codes, and the results are compared. The progress of the development work on a MUTRAP multigroup shield transport programme is described. Measurement of the radiation curve in a shielding penetration is described. (auth)

49587 (N-69-32317) CAUSES, MEASUREMENT, AND ELIMINATION OF FUEL ELEMENT FISSION PRODUCT LEAKAGE AT THE NASA PLUM BROOK REACTOR. Davis, A. Bert; Brickley, Richard H. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Aug. 1969. 28p. (NASA-TN-D-5374). CFSTI.

Fission product leakage from the fuel elements of the Plum Brook Reactor (PBR) Facility resulted from corrosion and physical damage of the elements. The causes of the corrosion and physical damage are discussed. A method of measuring fission product release from irradiated elements and a method of remote disassembly and examination of leaking elements in the PBR Hot Laboratory Facility are described. The use of the ^{133}I to ^{131}I ratio and a ^{17}N fission product monitor in detecting the injection and source of fission products in the reactor cooling water system are discussed. (auth) (STAR)

49588 (N-69-33132) SIGNIFICANT EXPERIENCES OF THE NASA PLUM BROOK REACTOR FACILITY. Barkley, H. B. Jr. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Aug. 1969. 16p. (NASA-TM-X-1853; CONF-681101-40). CFSTI.

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C.

Representative facility oriented and experiment oriented accomplishments of the NASA Plum Brook Reactor Facility at Sandusky, Ohio, are presented. Several significant problems solved are described. To provide a context for understanding the information, a brief description of the facility, its purposes, and the experimental program and environments are included. (auth) (STAR)

49589 PULSING NUCLEAR REACTOR. MacPhee, John (to Hittman Associates, Inc.). U. S. Patent 3,466,225. Filed Oct. 12, 1965.

A research reactor of the swimming pool type which is pulsed is described. A ratio of moderating liquid to UO_2 present in the core provides adequate excess reactivity and is sufficiently small to achieve an adequate Doppler coefficient of reactivity. (Offic. Gaz.)

49590 INFLUENCE OF RADIATION LOOP ACTIVITY GENERATOR'S ELEMENTS IN A GRAPHITE REFLECTOR ON THE ACTIVE SECTION OF AN IRT REACTOR. Dindun, A. S.; Gavar, V. V.; Mikel'son, A. E.; Tomson, E. Ya. (Inst. of Physics, Riga). Latv. PSR Zinat. Akad. Vestis, Fiz. Teh. Zinat. Ser., No. 2, 3-8(1969). (In Russian).

Experimental measurements of the influence on the reactivity of the reactor by various activity generators of the radiation loop and their constructional elements situated in a graphite reflector are described. The effect on the reactor caused by substituting the water reflector for graphite is also investigated. (auth)

49591 ON-LINE SPECTRAL ANALYSIS OF REACTOR NOISE. Szatmary, Zoltan; Valko, Janos (Central Research Inst. for Physics, Budapest). Nukleonik, 12: 208-11(Aug. 1969).

The power spectrum of non-nuclear reactor noise has been studied by the autocorrelation method using an on-line connection to the computer. The reactor power and coolant flow rates have been varied. The effect of amplitude quantization including polarity correlation technic has been investigated. (auth)

49592 APPRAISAL STUDY OF REPORTED OPERATING EXPERIENCES OF VARIOUS FAST BREEDER REACTORS IN THE WORLD. V. BR-5. Nakagawa, Hiroshi; Futami, Tsuneo (Tokyo Electrical Power Co., Inc.). Nippon Genshiryoku Gakkaishi, 11: 555-61(1969). (In Japanese).

The operating experience of BR-5 is evaluated. (auth)

49593 NEUTRON ENERGY DISTRIBUTION MEASUREMENTS IN AN IRT-2000 NUCLEAR REACTOR AT THE ACADEMY OF SCIENCES OF THE LATVIAN SSR. Lapenas, A. A.; Lapenas, V. K.; Praulin'sh, V. V. (Inst of Physics, Riga). Latv. PSR Zinat. Akad. Vestis, Fiz. Teh. Zinat. Ser., No. 3, 9-15(1969). (In Russian).

The distribution has been measured by means of the activation method in three experimental channels of the reactor in neutron energy range 1.45 eV to 13 MeV. Resonance neutron distribution in the energy interval of 1.46 eV to 337 eV has been measured by seven resonance detectors employing the method of I/v contribution deduction. Fast neutron spectrum has been determined using threshold detectors in the energy range of 0.5 MeV to 13 MeV. Dirac's method has been applied to the processing of the experimental results. In the energy range of 1 keV to I MeV the energy distribution has been determined by means of the Hanton interpolation. (auth)

49594 InGaSn ALLOY ACTIVATION IN THE ACTIVITY GENERATORS OF RADIATION LOOPS ARRANGED IN THE GRAPHITE SECTOR OF AN IRT NUCLEAR REACTOR REFLECTOR. Dindun, A. S.; Gavar, V. V.; Mikel'son, A. E.; Tomson, E. Ya. (Inst. of Physics, Riga). Latv. PSR Zinat. Akad. Vestis, Fiz. Teh. Zinat. Ser., No. 3, 3-8(1969). (In Russian).

The activation of the In-Ga-Sn (24, 62, 14%) alloy has been studied in the generator elements located in the graphitic block ($600 \times 600 \times 550$ mm^3). The block was arranged along the small edge of the core. Specific and total activities are calculated on 1 MW reactor power for separate elements depending on their arrangement in the graphite reflector for the lattice system of one-row generators and for the lattice systems of double- and triple-row activity generators. The generator elements for all cases consist of steel pipes IX19H9T, D = $^9/_8$ mm, h = 500 mm. Detailed thermal neutron flow distribution in the graphite block and the thermal neutron flow variations at the arrangement of one-row activity generators in the graphite block are discussed. (auth)

49595 RADIONUCLIDES AND HYDROGEN PEROXIDE DETECTED IN THE PRIMARY COOLING WATER OF KYOTO UNIVERSITY REACTOR. Iwata, Shiro; Kiso, Yoshiyuki; Tamai, Tadaharu; Hashimoto, Tetsuo; Nishikawa, Sataro; Sasajima, Kazuhisa; Matsushita, Rokuji; Tanaka, Yoshiko (Kyoto Univ.). Annu. Rep. Res. Reactor Inst., Kyoto Univ., 2: 97-100(1969).

Fission products and radionuclides produced by neutron activation of reactor materials were determined by a solvent extraction method, an adsorption method, a distillation method, and a coprecipitation method in order to determine the effects of operation at 5 MW on cooling water activity. Hydrogen peroxide was analyzed by colorimetry. (H.D.R.)

49596 MEASUREMENTS OF NEUTRON FLUX AND SPECTRUM AT IRRADIATION FACILITIES OF KYOTO UNIVERSITY REACTOR. Kanda, Keiji; Nanjyo, Tsutomu; Kobayashi, Katsuhei; Nakagome, Yoshihiro; Kimura, Itsuro (Kyoto Univ.). Annu. Rep. Res. Reactor Inst., Kyoto Univ., 2: 18-29(1969).

The neutron flux and spectrum at the irradiation facilities of Kyoto University Reactor (KUR) were measured by foil activation techniques. By using various kinds of foils, neutron fluxes in each of energy regions, namely thermal, epithermal and fast neutron regions, were absolutely measured. The deviations from the reference neutron spectrum in each energy region were also evaluated. For the experiments with these facilities, the spectral parameters and each flux are listed in tabular form. (auth)

49597 DESIGN AND INSTALLATION OF QUICK DETERMINATION APPARATUS OF URANIUM AND THORIUM IN ORES BY DELAYED NEUTRON ACTIVATION ANALYSIS. Liu, Chung Lin (National Tsing Hua Univ., Hsinchu, Taiwan). Ho Tsu K'o Hsueh, 6: No. 3-4, 109-21(Apr. 1969).

Apparatus for quick determination of trace quantity of U and Th by delayed neutron analysis has been built in the Tsing Hua Reactor. It takes about 1 minute for irradiation, 20 seconds delaying and 1 minute in counting for each sample whereas conventional chemical analysis will take many hours. With proper timing incorporated in the programming control system, this apparatus can handle up to 40 samples per hour by one operator. The apparatus was tested and calibrated with known U and Th samples and satisfactory results have been obtained. (auth)

49598 RADIOISOTOPE PRODUCTION BY IRRADIATION INSIDE A CYLINDRICAL FUEL ELEMENT. Nakamura, Haruto (Japan Atomic Energy Research Inst., Tokyo). Nippon Genshiryoku Gakkaishi, 11: 539-43(1969). (In Japanese).

The neutron flux and energy distribution inside the cylindrical fuel of JRR-2 used for irradiation have been measured by activation analysis, and the results compared with those obtained by irradiation at the same position without the fuel. Threshold detectors such as nickel and sulfur were used to measure the fast neutron flux. Gold and cobalt metal foils were used as thermal neutron monitor. In order to measure the contribution of resonance neutrons to the effective activation cross section, elements possessing different resonance neutron absorption energies were irradiated along with the flux monitors. It was estimated that approximately 30% of the thermal neutrons were converted to fast neutrons inside the cylindrical fuel and that the fast neutron flux was 6 times as high as obtained in the absence of fuel material, but that the epithermal index was found unchanged. 10 references. (auth)

Rocket and Space Reactors

Refer also to abstracts 48326.

49599 (AI-AEC-12839) REACTOR-THERMOELECTRIC SYSTEM FOR NASA SPACE STATION. Gylfe, J. D.; Johnson, R. A. (Atomics International, Canoga Park, Calif.). July 1, 1969. Contract AT(04-3)-701. 93p. Dep. CFSTI.

The results of a study regarding the design, integration, and operation of nuclear reactor-thermoelectric power systems for Earth-orbiting manned space stations are presented. The nuclear power system design and operation are described. 6 references. (auth)

49600 (N-69-30675) SUBSYSTEM RADIATION SUSCEPTIBILITY ANALYSIS FOR DEEP-SPACE MISSIONS: A REPORT COVERING TASK 2A EFFORT UNDER THE STUDY OF NASA EVALUATION WITH MODELS OF OPTIMIZED NUCLEAR SPACECRAFT (NEW MOONS). West, William S.; Poch, W; Holmes-Siedle, A.; Bilsky, H. W.; Carroll, D. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Apr. 1969. Contract NAS5-10441. 195p. (NASA-TM-X-63591; X-701-69-171). CFSTI.

Scientific, unmanned spacecraft on missions to Jupiter and beyond will be subjected to nuclear radiation from the natural environment and onboard nuclear power sources which may be harmful to subsystems. This report postulates these environments and discusses practical considerations to assure confidence that the spacecraft's materials and subsystems will withstand the effects of anticipated radiation. Degradation mechanisms are discussed. (auth) (STAR)

49601 (UCRL-50004-67-3(Pt.2)) ADVANCED SPACE NUCLEAR POWER PROGRAM. Quarterly Report, July-September 1967. (California Univ., Livermore. Lawrence Radiation Lab.). 12p. Dep. CFSTI.

Metallographic examinations of UN/W and UN/Re-W samples after isothermal annealing are described. The solubility of nitrogen in liquid metals is examined for UN/Ag couples. Shielding calculations for the SNAP 50 system are presented. (2 references) (D.C.C.)

49602 (UCRL-50004-67-4(Pt.1)) ADVANCED SPACE NUCLEAR POWER PROGRAM. Quarterly Report, October-December 1967. (California Univ., Livermore. Lawrence Radiation Lab.). 73p. Dep. CFSTI.

Mechanical properties of chemical-vapor deposited Re-W alloy tubing are analyzed. High density synthesis and fabrication procedures for UN are described. Phase equilibrium and vaporization studies are discussed. Physics measurements for the SPR-4 are presented. The effects of strengthened cermet matrix and void spaces on fuel swelling in space vehicle power reactors are analyzed. Reference design parameters for the SPR-6 and SPR-7 systems are included. 34 references. (D.C.C.)

49603 (UCRL-71149) FAST REACTOR SYSTEMS FOR SECONDARY SPACE POWER. Podney, W. N.; Garelis, E.; Koponen, B. L.; Layton, J. P. (California Univ., Livermore. Lawrence Radiation Lab.). June 19, 1968. Contract W-7405-eng-48. 28p. (CONF-680802-8). Dep. CFSTI.

From 3rd Annual Intersociety Energy Conversion Engineering Conference, Boulder, Colo.

A concept is presented for a fast reactor that can provide the long-lived, versatile, high-temperature (1500°K) heat source required for space applications in the 1980's, which will need secondary electrical power of 100 kW(e) or more. The concept is based on a core composed of UN fuel elements, enriched in either ^{235}U or ^{233}U that are clad with a ductile W alloy and cooled with Li, either by convective flow of the liquid or by vaporization of Li in heat pipes made of the same W alloy. A 250-kg cylindrical core, 26 cm in both diameter and length and fueled with ^{235}U, can produce 7 MW-years of thermal energy; a ^{233}U-fueled core having a mass of 80 kg and a diameter and length of 18 cm can produce 2 MW-years of thermal energy. A preliminary comparative study of advanced systems based on a fast reactor heat source and using either an alkali-metal Rankine cycle, inert-gas Brayton cycle, silicon-germanium thermoelectric elements, or out-of-core thermionic diodes to produce electrical power indicates that differences in performance between the systems may not be appreciable below a power level of 100 kW(e) and that Rankine-cycle and thermionic systems alone can provide the very high performance required at power levels approaching 1 MW(e). 26 references. (auth)

49604 SPACE TIME RESPONSE OF A NUCLEAR POWERED ROCKET ENGINE WITH VARIOUS INPUT RATES. Whittier, M.; Shen, C. N. (Rensselaer Polytechnic Inst., Troy, N. Y.). Elec. Eng. Trans., Inst. Eng., Aust., EE5: 7-12(Mar. 1969).

Maximum core temperature, maximum thermal stress, and thrust level are of great interest in the performance of a nuclear rocket engine. Numerical results for the above mentioned quantities are given for various input rates of the coolant flow and the power generation. The numerical evaluation of the analytical solutions in integral form is found to be very efficient. (auth) (Australia)

Process Heat and Desalination Reactors

49605 (STI/DOC-10/93) COST OF WATER FROM A SINGLE-PURPOSE MULTI-STAGE FLASH PLANT WITH VAPOUR RECOMPRESSION. Technical Reports Series No. 93. (Applied Research and Engineering Ltd., Durham (England)). 1968. 73p. (IAEA-R-537-F). IAEA $2.50. Dep.

For International Atomic Energy Agency, Vienna (Austria).

The cost of water from a single purpose MSF/Recompression plant is calculated and compared to the cost of water from a dual purpose plant. The cost of water from a plant producing both water and power separately from a common reactor is also determined. (auth)

49606 IRON PRODUCTION WITH ENERGY FROM NUCLEAR REACTORS. Wenzel, W. Klepzig Fachber, No. 77, 105-9(Feb. 1969). (In German).

The various possibilities for the application of energy obtained from nuclear reactors in the production of iron and steel are considered. (UKAEA Info. Bull)

49607 NUCLEAR DESALINATION. Proceedings of a Symposium on Nuclear Desalination, Held in Madrid, 18-22 November 1968. First Supplement to Desalination, the International Journal on the Science and Technology of Water Desalting. New York, American Elsevier Publishing Company, Inc., 1969. 953p. $38.50. (In several languages). (CONF-681108).

Included are 63 papers on the technical and economic aspects of nuclear desalination and on the various national programs concerned with desalting. A separate abstract was prepared for each of 46 individual papers. Three papers were previously abstracted for NSA and can be located under CONF-681108 in the report number index. (H.D.R.)

For abstracts of individual papers see: 47684, 47685, 48345, 48381, and 49608-49649.

49608 PRACTICAL CONSIDERATIONS IN DESALINATION AND ENERGY DEVELOPMENT AND UTILIZATION. Ramey,

J. T. (Atomic Energy Commission, Washington, D. C.). pp 3-16 of Nuclear Desalination. New York, American Elsevier Publishing Co., Inc., 1969.

From Symposium on Nuclear Desalination, Madrid, Spain. See CONF-681108.

The practical aspects and problems of initiating and implementing large-scale nuclear desalination plant projects are discussed. The need to construct and operate varied demonstration projects to obtain experience necessary to fully support the introduction of large-scale desalination for commercial application is emphasized. The fundamental reasons for large-scale nuclear desalination plants are updated. Comments are presented on the development and establishment of an adequate technological base. Among the problem areas covered are the need for preliminary engineering and economic studies and for the consideration of all potential benefits and problems; the proper use of economic standards in determining the cost and value of the water produced; the nature of the project financing; the organization and management of the project to accommodate the various types of utilities and the different countries which may be parties to the project; and the establishment of an appropriate project schedule. The status of the effort and planning on industrial and agro-industrial energy centres is summarized. (auth)

49609 THE UNITED KINGDOM APPROACH TO DESALINATION AND NUCLEAR POWER. Kronberger, H. (United Kingdom Atomic Energy Authority, Risley, Eng.). pp 17-23 of Nuclear Desalination. New York, American Elsevier Publishing Co., Inc., 1969.

From Symposium on Nuclear Desalination, Madrid, Spain. See CONF-681108.

Both desalination and nuclear power production are well-established technologies in the United Kingdom. The coupling of the systems presents no problems. Reasons for the slow acceptance of nuclear dual-purpose water/power schemes as a solution to water-supply problems are examined. The aims, scope and organization of the United Kingdom national program are outlined. (auth)

49610 FRENCH SEA-WATER DESALINATION PROGRAM. Balligand, P. (CEN, Grenoble, France). pp 25-9 of Nuclear Desalination. New York, American Elsevier Publishing Co., Inc., 1969. (In French).

From Symposium on Nuclear Desalination, Madrid, Spain. See CONF-681108.

The French seawater desalination program is being conducted both by government bodies and by private industrial concerns possessing their own design offices. To coordinate the various aspects of the work, a committee on desalination was established in 1966 under the chairmanship of the Minister of State responsible for scientific research. The Commissariat à l'énergie atomique, in cooperation with the Directorate General of Scientific and Technological Research, is responsible for implementing the committee's decisions and for coordinating research and development. The program covers practically all the processes under investigation throughout the world with the exception of the freezing process. The CEA is conducting basic research on materials, physics and chemistry, and heat transfer. Economic marketing studies are being undertaken in cooperation with the Ministry of Industry. Regarding the plant which could be associated with nuclear reactors, the CEA is engaged in optimizing a preliminary project for a plant combined with a gas-graphite reactor of the Saint-Laurent-des-Eaux II type. At present the tendency in the preliminary project is to combine the vertical-long-tube process with the flash process. (auth)

49611 FIFTEEN YEARS OF PROGRESS: A REVIEW OF THE UNITED STATES DESALTING PROGRAM. Edward, M. N. (Dept. of the Interior, Washington, D. C.). pp 41-9 of Nuclear Desalination. New York, American Elsevier Publishing Co., Inc., 1969.

From Symposium on Nuclear Desalination, Madrid, Spain. See CONF-681108.

The status of desalination technology at the time the US program was initiated and major activities that have been achieved are reviewed. The present status of freezing methods and membrane processes are discussed, but major emphasis is placed on the present state-of-the-art of distillation techniques and the utilization of nuclear reactors as an energy source for multi-million gallons-per-day water only, or dual-purpose power and water plants. Continued advances in desalination processes performance and efficiency that are anticipated are described together with comments on the effect these advances will have on the cost of product water. (auth)

49612 ROLE OF NUCLEAR ENERGY IN DESALINATION: A REVIEW OF THE UNITED STATES ATOMIC ENERGY COMMISSION'S DESALINATION DEVELOPMENT PROGRAM, PROBLEM AREAS, AND POTENTIAL. Williams, W. A. Jr.; Roberts, J. O.; McFarren, R. D. (Atomic Energy Commission, Washington, D. C.). pp 51-61 of Nuclear Desalination. New York, American Elsevier Publishing Co., Inc., 1969.

From Symposium on Nuclear Desalination, Madrid, Spain. See CONF-681108.

The origin and history of the U.S. Atomic Energy Commission's program, its objects and plans, and the considerations entering into the formulation and implementation of these plans are reviewed. The economics and technical features of nuclear energy in the production of desalted water and other industrial processes are discussed as well as the technical, economic, administrative and other considerations that have been encountered and the influences these considerations have on planning the development and demonstration of a new technology and its utilization. The roles of general and specific studies are outlined and how they contribute to the definition of development plans and program goals. (auth)

49613 TECHNICAL ASPECTS OF DESALINATION IN JAPAN: PRESENT AND FUTURE. Ishizaka, S. (Government Chemical Industrial Research Inst., Tokyo); Onaga, Y.; Kikuchi, T.; Sakai, T.; Suetsuna, I. pp 63-73 of Nuclear Desalination. New York, American Elsevier Publishing Co., Inc., 1969.

From Symposium on Nuclear Desalination, Madrid, Spain. See CONF-681108.

After 1975, especially in the Tokyo metropolitan area, the gradual cost increase of water seems unavoidable because the reliability of the water resources will become more difficult year after year. Therefore, the desalination of seawater is being studied ass a good means of overcoming the approaching water shortage. In addition, the demand for electricity in Japan has doubled during the last decade, and in accord with this tendency it is expected that the nuclear-power-plant capacity will be 30,000 to 40,000 MW in the 1980s. This trend, combined with the water problem, has brought nuclear desalination under consideration. (auth)

49614 COMBINATION OF A SEA-WATER FLASH-DISTILLATION PLANT WITH A NUCLEAR PLANT ARISING FROM EXPERIENCE GAINED WITH CONVENTIONAL INSTALLATIONS. Laban, H. (Atlas-MaK-Maschinenbau BmbH, Bremen); Hohenhinnebusch, W. pp 93-109 of Nuclear Desalination. New York, American Elsevier Publishing Co., Inc., 1969.

From Symposium on Nuclear Desalination, Madrid, Spain. See CONF-681108.

The Ceuta dual-purpose flash-distillation plant which produces 4000 m^3 of water per day and generates 5000 kW is examined. The experience gained in its construction and start-up and during several years of operation is described. The layout of the plant and the design of the components subject to corrosion by seawater, as well as their resistance to such corrosive attack are explained. Owing to the supply requirements, the operation of the plant involves prolonged shutdown periods and frequent starting up and shutting down. Based on the experience gained from this plant and numerous smaller installations, concepts for the development of large-scale plants in combination with nuclear-power stations are outlined. The possibility of combining a flash-distillation plant with a gas turbine power station because of the cheap supply of waste heat thus available is discussed at length. The cost aspects of such a dual-purpose installation are shown with reference to the various cycles on the basis of the results obtained from different calculations. The possibility of using a pebble-bed type reactor, on which initial operating experience is now available, is discussed in detail. (auth)

49615 DESALINATION OF SEA-WATER AND PRODUCTION OF ELECTRIC POWER: OPERATIONAL RESULTS OBTAINED BY THE ITALSIDER PLANTS AT TARANTO. Carolei, G.; Franzosi, C.; Jemma, M. (Societa Italiana Impianti, Genoa). pp 111-25 of Nuclear Desalination. New York, American Elsevier Publishing Co., Inc., 1969. (In French).

From Symposium on Nuclear Desalination, Madrid, Spain. See CONF-681108.

The plants are considered in a dual-purpose context and the relevant heat-cycle efficiencies are considered; it is noted that there is an increase in over-all efficiency as compared with plants for desalination only. The economic advantage of this solution is also connected with the possibility of selling the electrical power produced at the same time as the fresh water; hence, these plants are well suited to the needs of regions where industrial and social development is rapid and which are also close to large settlements of the agricultural and residential type. The large flash evaporation units installed in the Italsider Iron and Steel Works at Taranto can also be considered as dual-purpose plants since they utilize exhaust steam that has already undergone

two enthalpy steps, first in the turbo-alternators at the thermo-electric station, and then in two turbo-pumps. In connection with the latter installation, the operational results obtained and steps taken to overcome certain disadvantages due to the formation of scale and corrosion and to the presence of metal ions in solution in the distilled water produced are analyzed. The latter drawback has proved particularly undesirable in that some of the fresh water obtained is intended for use in high-pressure boilers. (auth)

49616 THE BOLSA ISLAND DUAL-PURPOSE NUCLEAR POWER AND DESALINATION PROJECT. Durante, R. W. (Dept. of the Interior, Washington, D. C.). pp 169-87 of Nuclear Desalination. New York, American Elsevier Publishing Co., Inc., 1969.

From Symposium on Nuclear Desalination, Madrid, Spain. See CONF-681108.

The reasons for, and basis of, the drastic increases in costs from those estimated for the feasibility studies to the present costs based on the receipt of firm proposals from manufacturers are examined. There have been several studies performed which analyze the costs in various ways; these are summarized and presented to identify the factors which caused the increase in estimated costs, the extent of their effect, and a discussion concerning whether they were a result of occurrences outside the scope and control of the project, or whether they were unforeseen by the feasibility study. The formation of a management organization and the decision-making events which took place relating to the matter of costs of the project are reviewed. (auth)

49617 UNITED STATES-MEXICO-IAEA STUDY OF LARGE NUCLEAR-POWER AND WATER-DESALINATION PLANTS FOR SOUTH-WEST UNITED STATES OF AMERICA AND NORTHERN MEXICO. Hunter, J. A. (Dept. of the Interior, Washington, D. C.). pp 189-206 of Nuclear Desalination. New York, American Elsevier Publishing Co., Inc., 1969.

From Symposium on Nuclear Desalination, Madrid, Spain. See CONF-681108.

Under the terms of an agreement signed in Washington in 1965 between the United States Government, the Government of Mexico, and the International Atomic Energy Agency, a joint study team has conducted a preliminary assessment of the technical and economic practicability of dual-purpose nuclear-power and water desalination plants to produce fresh water and electricity for the arid regions of the States of Arizona and California in the United States, and Sonora and Baja California in Mexico. The Gulf of California was considered as the water source for the plants. The study considers, for the first time, the total water needs of a vast arid region, including municipal, industrial and agricultural water. Following an initial evaluation of the scope of the project, the study team selected dual-purpose power-water plants producing 1 BGD of fresh water and 2000 MW electricity as the basic unit size. The siting of these plants is dependent upon seismological, geological, meteorological, geographical and ecological factors, all of which were considered by the study team in developing project economics. These considerations are presented, and details are provided on the information developed by the joint study team relative to: Plant design; location; conveyance systems (seawater and product water); brine disposal; over-all systems economics, and costs of plant products. (auth)

49618 POTENTIAL ECONOMIC DEVELOPMENT OF THE SOUTH-EAST REGION OF THE PROVINCE OF ALMERIA BASED ON THE INSTALLATION OF A DUAL-PURPOSE DESALINATION PLANT. Mac-Veigh Alfos, J. (Aquarius S. A., Madrid). pp 225-38 of Nuclear Desalination. New York, American Elsevier Publishing Co., Inc., 1969. (In Spanish).

From Symposium on Nuclear Desalination, Madrid, Spain. See CONF-681108.

On 12 June 1967 a group of Spanish promoters in conjunction with the Bechtel Corporation set up the Aquarius Company in Madrid to study the feasibility of, and subsequently to promote, the development of agriculture, industry and tourism in the south-east region of the Province of Almería, on the basis of construction of a large dual-purpose plant for the generation of nuclear-electric power and for the desalination of seawater. Their initiative was supported by the Spanish Ministry of Industry, which called upon the Nuclear Energy Board to give economic and technical assistance during the initial phase of the study. The preliminary work is summarized. Local conditions and the agricultural requirements and potential of the region, such as domestic and foreign markets for fruit and vegetables, are examined. The production and marketing potential of a variety of industrial products has been evaluated in the light of the resources of the region and of the requirements, production and output of the dual-purpose plant. An analysis is made of the potential of the Almería region from the standpoint of tourism together with a preliminary calculation of the facilities required and of potential revenue. A study is made of the labor available in the region so as to ascertain to what extent it may need to be increased. Furthermore, there is an analysis of the essential supporting factors, of the production and distribution of desalinated water and of requirements in terms of public and private infrastructures. Particular attention is given to sources of public and private finance, both Spanish and foreign, and to the organization required in order to carry out the project. In its entirety the preliminary investigation shows that the approach adopted is a logical one. (auth)

49619 STUDY OF THE VIABILITY OF A DUAL-PURPOSE NUCLEAR POWER STATION FOR THE REGION OF CATALONIA. Pascual, F. (Junta de Energia Nuclear, Madrid); Oltra, F.; Albet, J.; Costa, F.; Thio, L.; Torra, A. pp 261-76 of Nuclear Desalination. New York, American Elsevier Publishing Co., Inc., 1969. (In Spanish).

From Symposium on Nuclear Desalination, Madrid, Spain. See CONF-681108.

Within a relatively short space of time the region of Catalonia will be faced with water-supply problems due to the considerable increase in consumption as a result of industrialization and the development of tourism. Existing resources will need to be supplemented by supplies from outside sources. The possibility of ensuring the additional supply by the construction of a dual-purpose plant (generation of electric power and production of fresh water from seawater) is considered. A study is made of the characteristics of the region, its water requirements and their future development, together with available reserves, and it is concluded that by 1980 there will be need for an additional source of supply. Electrical power requirements in the region and their future development lead to the conclusion that by the same date a power station with a capacity of 500 to 600 MW(e) can be in operation with a utilization factor of 90%. An economic study of plants of various capacities operating under conditions obtaining in Spain and assuming various methods of financing is included. Here it is considered that the power station would be financed by the conventional methods used by electricity companies, whereas for the desalination plant various schemes used by water supply undertaking are taken into account. (auth)

49620 MARKET SURVEY OF WATER DESALINATION IN FRANCE, FOR SMALL UNITS. Dutheil, Francoise (CEA, Paris); Malissen, M. pp 277-87 of Nuclear Desalination. New York, American Elsevier Publishing Co., Inc., 1969. (In French).

From Symposium on Nuclear Desalination, Madrid, Spain. See CONF-681108.

On the initiative of the French Atomic Energy Commission and in close collaboration with it, the Society for Industrial Conversion and Development (SODIC) has made a very general study of coastal areas in France where the prospective water requirements on a short-, medium- and long-term basis and the cost of necessary water supplies are such that they could lead to the establishment of desalination units producing 3000 to 10,000 m^3/d as a competitive source. This study, which although of a general nature deals with some specific points in detail, has not yet brought to light any clear-cut possibilities in this respect. No final conclusions are reached in respect of small islands and units of much lower capacity, or of large units in coastal areas which would gain from greater size. Nevertheless, the probable difference between the cost of desalted water and the high market price already observed in a small number of coastal areas is relatively small. It would therefore be desirable as well as relatively inexpensive to set up an experimental desalination unit in the near future. (auth)

49621 HEAT SUPPLY TO A DESALINATION UNIT BY AN ORGANIC NUCLEAR SINGLE-PURPOSE REACTOR OF LOW POWER. Biondi, L. (Montecatini Edison S.p.A., Milan); Crispino, E.; Di Menza, R.; Gazzabin, F.; Merli, E.; Negrini, R.; Potesta, A.; Vacchelli, G. pp 291-5 of Nuclear Desalination. New York, American Elsevier Publishing Co., Inc., 1969. (In French).

From Symposium on Nuclear Desalination, Madrid, Spain. See CONF-681108.

Studies have been performed on the problems of supplying heat from a nuclear plant to a seawater desalination unit as a function of the plant's fresh-water capacity. The study is carried out for single-purpose and dual-purpose plants. It has been realized that in many places the needs of fresh water are not so important as to require the heat produced by big nuclear reactors of the present economic sizes. For such cases it may be more convenient to explore different solutions other than the conventional ones. For this application a single-purpose reactor producing only heat at low temperatures may be envisaged and convenient. Among the different concepts of reactor, it seems that the organic one has more advantages from the lowering of temperature and fewer disadvantages from the necessary reduction of size. The main

rules one must impose on this reactor and the expected corresponding performance are considered. (auth)

49622 DESIGN AND INSTALLATION OF THE ROVI REACTOR FOR DESALTING SEA-WATER. Cassinari, A. (ENI, Milan); Gandellini, A.; Vaudo, A. pp 297-310 of Nuclear Desalination. New York, American Elsevier Publishing Co., Inc., 1969. (In French).

From Symposium on Nuclear Desalination, Madrid, Spain. See CONF-681108.

The basic criteria for the design of a single-purpose low-power reactor for desalting seawater and the criteria for selecting optimum coupling between the reactor and a desalination plant are described. The use for this purpose of a reactor cooled and moderated by an organic fluid is considered in the light of experience recently gained in this field, particularly with regard to HB-40 as the coolant and moderator. The advantages of this solution over one employing terphenyl are pointed out. The ROVI reactor, designed for a power level of 100 MW(th) and a fresh-water output of 50,000 m^3/d, is described. Such technological problems as safety systems, fuel handling, ancillary cooling equipment, and the possibility of producing on the spot the power required by auxiliary plant facilities are discussed. Particular attention is given to an analysis of the reliability characteristics of the plant, the problem of reserve, and measures which might need to be taken in this connection. A preliminary estimate is made of the cost, with particular reference to the size of the different facilities. (auth)

49623 THE ROVI REACTOR: SELECTION OF THE FUEL ELEMENT AND RELATED PROBLEMS. Biondi, L. (Montecatini Edison S.pA, Milan); Panzeri, D.; Pierazzi, L. pp 311-18 of Nuclear Desalination. New York, American Elsevier publishing Co., Inc., 1969. (In French).

From Symposium on Nuclear Desalination, Madrid, Spain. See CONF-681108.

The ROVI reactor, which is cooled and moderated by the organic fluid HB-40, has a capacity of 100 MW(t) and is intended for a water-only plant with a production of 50,000 m^3/d of fresh water. Several solutions come under consideration for its core and fuel element. The various alternatives are discussed, paying particular attention to the advantages and disadvantages of each, bearing in mind the particular purpose for which the reactor is intended. The reference solution selected is one which uses uranium carbide clad with SAP (sintered aluminum powder). This solution gives rise to problems relating to the behavior of SAP under creep conditions owing to the swelling of the uranium carbide. Several technological solutions are described, with particular reference to those that so far appear to offer the most advantages and greatest safety. (auth)

49624 PRESSURIZED-WATER REACTORS FOR NATURAL AND ENRICHED URANIUM. Drude, B. C.; Roehl, F. H. (Siemens Aktiengesellschaft, Erlangen, Ger.). pp 319-30 of Nuclear Desalination. New York, American Elsevier Publishing Co., Inc., 1969.

From Symposium on Nuclear Desalination, Madrid, Spain. See CONF-681108.

Pressurized-water reactors are particularly well suited for high-capacity desalination plants. The H_2O and D_2O-cooled pressurized-water reactors developed by the Siemens Company represent but two modifications of a common line, as evidenced by juxtaposition of the Obrigheim 300-MW(e) and the Atucha 318-MW(e) plants. When selecting a nuclear steam generator the balance may be turned in favor of the one or the other type by considerations of economic policy. Reactors of either modification with capacities up to 600 MW(e) in steel or concrete pressure vessels have been designed and are available. Nuclear dual-purpose plants for electric power and process-steam generation are now rapidly gaining in importance. Technical and economic characteristics of high-powered units as required by the chemical industry have been studied closely for various flow schemes and ratings. Advantages and disadvantages of the back-pressure turbine cycle, offering the highest water-to-power ratio, are examined on the basis of realistic operating conditions. The economy of the plants may be improved by increased power production and adoption of suitable flow schemes. The advantages and disadvantages incurred by an extraction turbine or by a combination of back-pressure and condensing turbines are discussed, and specific investment and production costs of power and process steam illustrated by giving examples. For any particular case the two main constituent parts of a dual-purpose plant may thus be chosen from among reactors of different design and characteristics, and evaporators of different origin, with the reactor builder being responsible only for the nuclear part or, alternatively, acting as a general contractor within the framework of a consortium. (auth)

49625 THE STEAM-GENERATING HEAVY-WATER REACTOR IN DUAL-PURPOSE APPLICATIONS. Chambers, S. (United Kingdom Atomic Energy Authority, Winfrith, Eng.). pp 331-40 of Nuclear Desalination. New York, American Elsevier Publishing Co., Inc., 1969.

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The use of the steam-generating heavy-water reactor (SGHWR) in dual-purpose applications is discussed. In view of the state of development of multi-stage flash (MSF) evaporation plant, and the doubtful advantage of increasing the maximum brine temperature, it is argued that for some years to come commercial plants will not exceed 12 MGD, nor will the maximum brine temperature exceed 240°F. A study has been made of the base load SGHWR-MSF evaporation system over a range of water outputs of 60 to 240 MGD and a range of net electrical outputs from 100 to 400 MW. Optimization has been carried out on the basis of minimum total operating cost, but to derive the water cost an electricity credit appropriate to the equivalent single-purpose power station has been allowed. Cost contours are drawn therefore, for plant combinations which could be built with confidence on current technology, against water production and electrical output for a range of capital charge-rates and load factors. (auth)

49626 SOME FEATURES REQUIRED OF NUCLEAR REACTORS FOR DUAL-PURPOSE WATER/POWER PRODUCTION. Kronberger, H. (United Kingdom Atomic Energy Authority, Risley, Eng.). pp 341-9 of Nuclear Desalination. New York, American Elsevier Publishing Co., Inc., 1969.

From Symposium on Nuclear Desalination, Madrid, Spain. See CONF-681108.

A new approach to reactor operation due to a dual-purpose function over its lifetime is outlined. The background, technical features and operating experience of UK-designed reactors (AGR, SGHWR, HTR, PFR) with special references to their utilization in high-load, dual-purpose water/power systems are discussed. (auth)

49627 THE SODIUM-COOLED FAST-BREEDER REACTOR AS A HEAT SOURCE FOR DESALINATION PLANTS. Langley, R. A. Jr.; Clark, R. L. (Bechtel Corp., San Francisco). pp 351-63 of Nuclear Desalination. New York, American Elsevier Publishing Co., Inc., 1969.

From Symposium on Nuclear Desalination, Madrid, Spain. See CONF-681108.

The technical problems and design considerations in using a sodium-cooled fast-breeder reactor as a heat and power source for desalination plants are discussed. Both dual- and single-purpose plants are considered. The effects of plant size and type of desalination process are treated as they affect nuclear-power plant design. Trends in plant size and the possible evolution of sodium-cooled fast-breeder reactors are discussed. Technical considerations treated include the selection of plant operating temperature, the steam cycle for the dual-purpose plant, the ratio of electric power output to process steam, steam generator design, the need for a tertiary water loop between the liquid metal and the brine heaters, and containment design. These problems are discussed in terms of the 250–500 MW(e) plants now undergoing preliminary design in the United States of America and the 1000-MW(e) plants being studied as a part of the U.S. Atomic Energy Commission liquid metal fast-breeder reactor (LMFBR) program. Design evolution of the sodium-cooled fast-breeder reactor as a dual-purpose or single-purpose energy source, as it is affected by application to desalination, is considered. The most significant potential advances, including elimination of intermediate loops, on-line refueling, and changes in "design basis accidents," are discussed. Evaluations of the cost of power and water for dual- and single-purpose plants as functions of plant size are made and results provided. Estimates of possible future power and water-cost reductions as a result of design evolution and the development of a viable industry are also included. (auth)

49628 APPLICATION OF THE HTGR–CCGT SYSTEM IN DUAL-PURPOSE NUCLEAR-POWER PLANTS. Halzl, J.; Szabo, Z.; Szuecs, L.; Torma, M. (Thermo-Energy Design Bureau, Budapest). pp 367-83 of Nuclear Desalination. New York, American Elsevier Publishing Co., Inc., 1969.

From Symposium on Nuclear Desalination, Madrid, Spain. See CONF-681108.

The idea of using the HTGR-CCGT (High-Temperature Gas-Cooled Reactor Closed-Cycle Gas-Turbine) system for the simultaneous supply of heat and electricity is developed and applied to alumina-aluminium producing industrial complexes and to water desalination. General investigations concerning the suitability of the CCGT system for the combined production of heat and electricity are presented. On the basis of thermodynamic analysis — considering also the special features of the

equipment involved—the optimum heat cycles dependent on the characteristics of the heat demand are shown. HTGR-CCGT dual-purpose power plants for two selected cases are described. Heat cycles are presented which are suitable for the combined heat and electricity supply of alumina-aluminium producing industrial complexes. The application of the HTGR-CCGT system to water desalting is discussed. It is shown that the combination of the multi-flash and the humidification processes offers special advantages. The influence of the heat-exchanger costs on the overall economy of the CCGT system is emphasized. To reduce the specific costs, the use of mercury as heat-transmittant medium in specially designed equipment is suggested. Solutions are presented concerning the design of the heat exchangers. Several diagrams for the dimensioning of high-efficiency plate fins used in the very compact heat exchangers are included. The diagrams take into account both the temperature variation of the temperature field, existing in the gas flow, and the heat conduction of the fin, also in the direction of the flow. (auth)

49629 OPTIMUM SYSTEM FOR SATISFYING A GIVEN DEMAND ON FRESH WATER AND ELECTRIC POWER. Heller, L.; Szuecs, L. pp 385-93 of Nuclear Desalination. New York, American Elsevier Publishing Co., Inc., 1969.

From Symposium on Nuclear Desalination, Madrid, Spain. See CONF-681108.

The optimum supply of simultaneous demand for both fresh water and electric power in such areas where the output of the dual-purpose nuclear plant is comparable with the consumption of the region is discussed. In such areas the advantages of back-pressure power generation are often not fully utilized. The reason is the lack of consumers for the power generated. The best solution is to utilize all the possibilities given by back-pressure power generation and to use the mechanical or electric energy gained (and unsaleable) for desalting seawater by processes which require this type of energy (e.g., heat pump, freezing process, electrodialysis, etc.). A method is presented by which the optimum combination of processes with the optimum share of the different types of equipments in meeting the demands as well as the optimum freshwater and electrical output, taking into consideration the given conditions, can be established. The following problems are examined: (1) In a closed consumption region both new freshwater production and new electric power production reduce the value and therefore also the selling price of the product in question. This factor mostly influences the optimum output; (2) When using a combination of processes instead of one process, the unit capacity generally diminishes. This factor influences the specific costs of the products; (3) In some combined processes the convertible part of the heat, or the generated mechanical-type energy, can be used for driving desalination equipment directly, without any electric or other coupling. The specific costs of freshwater, produced, e.g., by freezing, heat-pump type, etc., processes, applied in combination, are much lower than if the same processes are applied independently; (4) The combined system makes it possible to exploit the full electric power capacity also in the low-load period, producing in this period easily storable fresh water. It is a very advantageous feature, especially with nuclear applications. Several examples are given to illustrate the above. Multi-flash and heat-pump combinations, especially multi-flash and injector-type heat-pump combinations, are treated in detail. (auth)

49630 DESALINATION PLANTS USING HIGHER STEAM PRESSURES. Pechenick, W.; Ennis, C. E. (Catalytic Construction Co., Philadelphia). pp 397-405 of Nuclear Desalination. New York, American Elsevier Publishing Co., Inc., 1969.

From Symposium on Nuclear Desalination, Madrid, Spain. See CONF-681108.

The economic factors involved in the use of steam pressures up to 160 lb/in.^{2} g in single-purpose desalination or dual-purpose power-desalination plants are discussed. (H.D.R.)

49631 COMBINATION OF A HIGH-TEMPERATURE REACTOR WITH A CLOSED-CYCLE GAS-TURBINE AND DESALINATION PLANT. Ehret, A.; Sonnenschein, H. (Gutehoffnungshuette, Oberhausen, Ger.). pp 407-17 of Nuclear Desalination. New York, American Elsevier Publishing Co., Inc., 1969.

From Symposium on Nuclear Desalination, Madrid, Spain. See CONF-681108.

High-temperature reactors with closed-cycle gas turbines are suitable for combination with a desalination plant since, even in the course of normal operation, waste heat is partly available at a sufficiently high temperature level to permit its use as process heat. To increase the water production in a dual-purpose plant several methods are available to increase basically the quantity of process heat in a closed gas-turbine cycle. Which of these methods is the most economic one depends on several operating conditions. In some cases the loss of electric power with increasing process heat supply is extremely low. Therefore, the cost of this additional heat is also extremely low and water production in such a plant is very economical. When combining a gas-turbine circuit with a MSF evaporation plant some special conditions of adaptation arise from the fact that the temperature of the working fluid is not constant during reheat extraction. From this a strong dependence between freshwater output and maximum brine temperature, specific heat consumption in the desalination plant and process heat supply from the gas turbine plant would result if the most economic design of the dual-purpose plant is desired. (auth)

49632 OPTIMIZATION STUDY ON THE COUPLING OF A LOW-TEMPERATURE ROVI REACTOR WITH A DESALINATION PLANT. Nebbia, G. (Bari Univ., Italy); Di Menza, R.; Pierazzi, L. pp 419-24 of Nuclear Desalination. New York, American Elsevier Publishing Co., Inc., 1969.

From Symposium on Nuclear Desalination, Madrid, Spain. See CONF-681108.

In the coupling of a nuclear reactor to a distillation plant for desalination of seawater, the temperature at which the latter can be operated represents a very determining factor. An optimization study of the effects, both on the nuclear steam-generating reactor and on the distillation part, of varying the temperature of operation from the values used today as those that it is hoped will be reached in the future is presented. (auth)

49633 STUDY OF DESALINATION PLANTS COUPLED TO A NUCLEAR REACTOR OF THE NATURAL URANIUM/GAS/GRAPHITE TYPE AND OPERATING BY VARIOUS PROCESSES. Balligand, P.; Agostini, J. P.; Huyghe, J.; Lauro, F.; Vignet, P. (CEN, Grenoble, France). pp 425-40 of Nuclear Desalination. New York, American Elsevier Publishing Co., Inc., 1969. (In French).

From Symposium on Nuclear Desalination, Madrid, Spain. See CONF-681108.

The thermodynamic conditions (temperature and seawater concentration) that must be observed in order to avoid scaling of the exchange surface during the distillation of acidified and decarbonated seawater are given by the solubility diagram for the different forms of calcium sulphate. In the conventional methods of flash or multiple-effect distillation it is possible to eliminate all risk of saline deposits by keeping the evaporation paths on the calcium sulphate solubility diagram below the anhydride saturation curves; but to do so narrows the working temperature range and thereby limits the production of water. If the evaporation path is limited by the hemihydrate saturation curve, the risk of saline deposits exists, but the production of water increases. Freshwater plants coupled to a nuclear reactor of the natural uranium/gas/graphite type are studied for these two cases from the point of view of: (1) the conventional flash process; (2) a cycle combining lines operating by the flash process with and without recycling; (3) the multiple-effect process using LTV evaporators; and (4) a cycle combining multiple-effect and flash processes. Examples of use under given economic conditions are cited. (auth)

49634 THE SELECTION OF NUCLEAR POWER AND DESALINATION PLANTS FOR AUGMENTING EXISTING WATER RESERVES. Masters, E. F.; Matthews, H. A.; Orde, F. K. (Associated Nuclear Services, London). pp 441-62 of Nuclear Desalination. New York, American Elsevier Publishing Co., Inc., 1969.

From Symposium on Nuclear Desalination, Madrid, Spain. See CONF-681108.

Nuclear desalination is generally discussed and studied in the context of large capacities and high levels of utilization, the latter inferring base load requirements of high order of production. The possibility of utilizing reactors of the lower range of output to meet less favorable demands likely to arise under the more general circumstances are considered. Such demands are likely to occur prior to the ideal large-scale nuclear desalination and ways are discussed of how characteristics of reactors, power systems and water systems may be employed to obtain the most economic solution. It is suggested that the high availability characteristics of nuclear reactors can be exploited to this end. Reference is made to the desirable characteristics of desalination plant and the attainment of lower water costs. (auth)

49635 COMBINED PRODUCTION OF ELECTRIC POWER AND DESALINATED WATER USING VULCAIN REACTORS AND LTV UNITS: TECHNICAL AND ECONOMIC ASPECTS OF MEDIUM-POWER PLANTS. Maldague, P. (BelgoNucleaire, Brussels); Descampe, Cl.; Debay, W.; Paquet, A.; Bongard, W.; Cox, B. pp 463-79 of Nuclear Desalination. New York, American Elsevier Publishing Co., Inc., 1969. (In French).

From Symposium on Nuclear Desalination, Madrid, Spain. See CONF-681108.

By combining a 280-MW(t) variable-moderation nuclear steam generator of the Vulcan type with an LTV-type desalination plant it is possible to establish a dual-purpose station producing about 61 MW(e) of electricity and 91,000 m^3/day (24 MGD) of fresh water. Assuming a cost of 8 mill/kWh for the electricity — a cost corresponding to normal economic conditions — the cost of the water would be about 51.1¢/1000 gal (6.75 B.Fr./m^3). This cost could be reduced to 40.1¢/1000 gal (5.3 B.Fr./m^3) by assuming more favorable financing (6% per year) of the investments associated with the desalination plant. (auth)

49636 OPTIMUM BRINE TEMPERATURE IN NUCLEAR AND FUEL-OPERATED POWER PLANTS COUPLED WITH MULTI-STAGE FLASH EVAPORATOR. Kunst, B. (GHH-M.A.N. Technik, Essen). pp 483-94 of Nuclear Desalination. New York, American Elsevier Publishing Co., Inc., 1969.

From Symposium on Nuclear Desalination, Madrid, Spain. See CONF-681108.

The project engineer dealing with the design of MSF evaporation plants has two main resources for increasing the freshwater production when the power output is fixed—installing more condensing area and raising the brine-heater steam temperature. This measure has different economic consequences depending on the type of plant considered, e.g., nuclear or fuel-operated power plant, steam or gas turbine. Several aspects concerning the variable brine temperature are investigated by means of a FORTRAN-IV program of about 60 K capacity (60,000-word) requirement. The costs of power and water when produced separately are computed for comparison. Thus the economical advantage of the combined production can be assessed. (auth)

49637 HIGH-TEMPERATURE DESALINATION PLANTS FOR NUCLEAR-POWER STATIONS. Tidball, R. A.; Gaydos, J. G. (Baldwin-Lima-Hamilton Corp., Philadelphia). pp 495-506 of Nuclear Desalination. New York, American Elsevier Publishing Co., Inc., 1969.

From Symposium on Nuclear Desalination, Madrid, Spain. See CONF-681108.

The maximum temperature to which the brine can be heated in a MSF plant affects both the capital costs and energy costs charged to the product water. It has been demonstrated at the OSW East Coast Test Facility that fresh seawater can be treated with sulphuric acid and heated in a "once-through" plant to 300°F without scale formation in the condenser tubes. It has also been demonstrated that when the seawater is recirculated with or without concentration, scaling will occur at temperatures above 270°F. A combination of a "once-through" high-temperature effect with either a single-effect multi-stage (SEMS) flash plant or a multi-effect multistage (MEMS) flash plant can be utilized to reduce both capital cost and energy charges. The purity of the product water from most MSF plants varies between 5 and 100 ppm TDS. Purer water can be made (down to approximately 1 ppm) at an increase in capital cost. Make-up water for modern fossil-fuel boilers or for primary systems of nuclear reactors requires water containing as little as 0.05 ppm. Generally, a small part of the product water of a desalination plant is passed through a demineralizer to obtain the desired purity for make-up. However, a method is available to produce a few percent of the total product as very-high-purity water. This process is presented and included in the design of the proposed plants. The capital charges, energy charges and chemical charges are compared for 150-MGD plants using the SEMS, MEMS and the "once-through" topping plant in combination with both. The cost of water is presented based on these adaptations to the MWD (Metropolitan Water District, Los Angeles, California) study. (auth)

49638 THE CHARACTERISTICS OF DUAL-PROCESS DISTILLATION PLANT COMBINING VAPOUR COMPRESSION AND MULTI-STAGE-FLASH EVAPORATORS. Wood, F. C.; Herbert, R. (United Kingdom Atomic Energy Authority, Winfrith, Eng.). pp 535-55 of Nuclear Desalination. New York, American Elsevier Publishing Co., Inc., 1969.

From Symposium on Nuclear Desalination, Madrid, Spain. See CONF-681108.

Vapor-compression evaporation is of interest for dual-purpose and single-purpose desalination plants because of its relatively low energy demands and heat-transfer surface requirements. As a hybrid plant operating in conjunction with a MSF evaporator considerable flexibility of output can be achieved for base load operation from a fixed heat source. The relationship of energy demands and heat-transfer surface for the vapor recompression process are examined from the thermodynamic standpoint and compared with those of other evaporation processes. It is concluded that the greatest advantage in terms of heat-transfer surface per unit of prime fuel is obtained for the hybrid process when the vapor compression evaporator (VCE) is coupled to the top end of the MSF plant either in single- or multi-effect. Various alternative coupling modes are considered, including the use of a secondary fluid in the vapor-compression work cycle. The relative outputs of the VD and MSF evaporators depend primarily upon the type of heat source available and the efficiencies of the heat and work cycles. Typical figures are presented for various combinations using boilers/steam turbines, gas turbines, diesels and jet compressors. The principal secondary variables are the operating temperature differences across the two kinds of evaporator. In the case of nuclear desalination plant the power-to-water ratio may be increased economically by using a proportion of the work produced at the steam turbine to drive the VCE. The influence of the choice of principal variables, including turbine pass-out pressure, upon operating costs is illustrated for a nominal 300-MW(e) advanced gas cooled reactor (AGCR) operating in dual- and single-purpose modes. Problems which must be solved before the proposed system can become viable include: (1) the development of large vapor compressors, developing 50,000 h.p. or more, of high availability; (2) demisting at ultra-high efficiency; (3) stability and control problems associated with coupled, high performance ratio, evaporators. (auth)

49639 NUCLEAR SINGLE-PURPOSE MULTI-STAGE-FLASH PLANT WITH VAPOUR RECOMPRESSION. Starmer, R.; Lowes, F. (Applied Research and Engineering Ltd., Durham, Eng.). pp 569-82 of Nuclear Desalination. New York, American Elsevier Publishing Co., Inc., 1969.

From Symposium on Nuclear Desalination, Madrid, Spain. See CONF-681108.

Some results of the work into the problems and economics of large-scale single-purpose MSF plants whose thermal performance is boosted by vapor recompression when powered by a nuclear heat source are presented. The cycle chosen was somewhat similar to a multi-effect multi-stage (MEMS) cycle as far as the flash evaporator is concerned but there is no inter-effect heat-rejection or heat-input section between the two heat-recovery sections used. Instead a flash stage is used to provide the vapor to be compressed for condensation in part of the heat-input section. This cycle is described, the main parameters selected or investigated are presented, and the main conclusions obtained from the economic study are summarized. A specific design of distillation plant selected to illustrate the practical features of such an arrangement is described. Site layout and distillation plant design features are presented, which are compared with those of straight large MSF plants at present being planned. A comparison of the water cost from such a plant and from a large nuclear dual-purpose plant using either pass-out or back-pressure steam for the distillation plant is included. For locations where both power and water are required, the concept is proposed of a single reactor supplying high-pressure steam to independent power and water stations. The cost of water obtained from the proposed plant and from the various alternatives is broken down into the main contributing features to illustrate the common problems and highlight areas where further investigation might reduce the cost of water from these plants. (auth)

49640 THE ECONOMIC DEVELOPMENT OF NUCLEAR DESALINATION PLANTS IN WATER AND POWER SUPPLY SYSTEMS. El-Ramly, N. A. (Univ. of Hawaii, Honolulu); English, J. M. pp 585-94 of Nuclear Desalination. New York, American Elsevier Publishing Co., Inc., 1969.

From Symposium on Nuclear Desalination, Madrid, Spain. See CONF-681108.

The factors and constraints affecting the economics of the system design are discussed. The relevant design variables are then incorporated into a mathematical framework to show the system interrelationship. It is indicated that the optimum development depends upon project timing in relation to the long-range demand functions of water and power. Furthermore, the decision is sensitive to interest rates, and demand growth patterns, and the system's economics of scale. The optimum product ratio is to be determined, to the extent permitted by technical constraints, on the basis of maximizing the present worth of the revenue minus cost streams. The effects of budget and other economic constraints as they pertain to the sequence of the total system development are also considered. The merits of cost allocation policies are investigated and their effect upon investment decisions are discussed. It is concluded that the proper method for allocating joint costs over the system economic life should be proportional to the revenue streams. The economic implication of technological changes upon the rate of equipment obsolescence is also discussed. (auth)

49641 INTEGRATING DUAL-PURPOSE PLANT FOR POWER AND WATER PRODUCTION INTO AN EXISTING ELECTRICITY SUPPLY SYSTEM. Goldsmith, K. pp 595-604 of Nuclear Desalination. New York, American Elsevier Publishing Co., Inc., 1969.

From Symposium on Nuclear Desalination, Madrid, Spain. See CONF-681108.

The technical and economic conditions under which the electrical power output from a dual-purpose plant producing electricity and water can be accommodated within the constraints of an existing electricity supply system are examined. First, the general principles governing generating-plant extension programs are dealt with and the factors limiting unit sizes pointed out. The operating regime demanded of various types of generating plant is illustrated with reference to daily and annual load curves of typical supply systems located in areas of potential water shortage. It is shown that, if a particular dual-purpose plant exceeds a critical size, which may be less than its optimum size, it will be of maximum value to the system if its power output can by cyclically or seasonally varied to suit the system requirements; water-production costs from this plant will then be lowest. This means that, with a constant amount of heat produced by the boiler or reactor of the dual-purpose installation, the heat/power ratio on the generating side may have to be altered, in the short term to keep it in step with the system load curve and in the long term to accord with the changing position of the power plant in the general order of merit of all other generating plant in the system. Water is then produced counter-cyclically, i.e., at a maximum rate at times of minimum power demand, any temporary water surplus being stored. Steam cycles for varying heat-power ratios are briefly reviewed and their economics discussed. The case for a large dual-purpose installation must be assessed with reference to the effect of this plant on the whole electricity supply system into which it is to fit. (auth)

49642 ECONOMIC CONSIDERATIONS OF A NUCLEAR ENERGY FACILITY FOR THE PRODUCTION OF CHEMICALS FROM SEA SALT IN DEVELOPING COUNTRIES. Terlizzi, P. M. (United Nations Industrial Development Organization, Vienna). pp 645-57 of Nuclear Desalination. New York, American Elsevier Publishing Co., Inc., 1969.

From Symposium on Nuclear Desalination, Madrid, Spain. See CONF-681108.

The economics of the production of chemicals from sea salt in developing countries utilizing nuclear fuel systems is examined. The use of selected nuclear systems versus solar evaporation techniques, freezing, and geothermal resources are discussed. The level of nuclear-fuel system sophistication that could possibly be utilized to economic advantage by developing countries is discussed in terms of technology, investment, personnel requirements and marketing economics of chemicals produced. (auth)

49643 DESALTED WATER AND THE POSSIBILITY OF ITS USE IN AGRICULTURE. Barrada, Y. (International Atomic Energy Agency, Vienna). pp 659-80 of Nuclear Desalination. New York, American Elsevier Publishing Co., Inc., 1969.

From Symposium on Nuclear Desalination, Madrid, Spain. See CONF-681108.

Where the development of natural freshwater resources is not feasible, desalination should receive close attention. Large-scale irrigation projects, or agro-industrial complexes based on nuclear desalination, are possible future solutions in arid coastal regions with high production potentials, a twelve-month cropping season and suitable marketing possibilities. When the cost of desalting waters becomes low enough to permit its use for agriculture it will be of great benefit to developing countries. The high costs and expertise required in the research and the development of desalination for general use require that projects be undertaken mainly by the developed countries, which possess the financial means, the necessary facilities and trained personnel. To plan large-scale desalination for agriculture a pilot experimental farm is recommended to prove that high yields can be achieved while applying economy in water use; adequate crops and crop rotation should be chosen. Substantial technological and financial cooperation from developed countries would be paramount in such a scheme. The conditions under which the experimental farm is operated must be well defined. Meteorological data should be recorded, soil characteristics be determined, to aid in predicting future yields, as well as the water requirements for other areas for which the necessary data could be made available. A small advanced desalination plant (using conventional fuel) should be installed to produce all or part of the irrigation water necessary for an experimental farm, and to enable the evaporator performance to be tested, techniques to be developed, the real cost of water production to be estimated, and the effect of water quality on yields and crop water requirements to be investigated. Regardless of the source of energy, desalination projects for irrigation could be realized when it is proved that agriculture can pay the cost of desalted water and still give a reasonable return on the capital invested. The production costs of desalted water are decreasing and beginning to overlap with the maximum that agriculture can afford to pay under favorable conditions for the production of specialty crops within easy access to large urban centers. (auth)

49644 A CONCEPTUAL NUCLEAR ENERGY CENTRE FOR THE CO-PRODUCTION OF AGRICULTURAL CHEMICALS AND DESALTED WATER TO SERVE A PILOT FOOD FACTORY. Bresler, S. A.; Miller, E. F. pp 683-95 of Nuclear Desalination. New York, American Elsevier Publishing Co., Inc., 1969.

From Symposium on Nuclear Desalination, Madrid, Spain. See CONF-681108.

The preliminary economic effects of ammonia plant scale on the cost of desalting seawater in dual-purpose systems with and without electric power production are examined. Included is one case based on the application of a nuclear reactor operated to heat helium for the in-situ reforming of hydrocarbons and the generation of high-pressure steam. These products of the nuclear energy center are utilized in ancillary facilities for the co-production of desalted water and anhydrous ammonia. The flow-sheet of a thermodynamically balanced plant is presented together with charts summarizing the preliminary cost estimates and unit costs for each primary product. The quantity of desalted water and anhydrous ammonia is ample to support a pilot food factory. How this chemical engineering flow-sheet could be adjusted in larger scaled operations, i.e., in giant food factories, to achieve an increased agricultural water-ammonia balance through the addition of facilities for the parallel production of steam, electric power and synthetic motor fuel is outlined. High-pressure steam could be used to increase the production of water by utilizing a vapor-compression recycle in conjunction with a multi-stage flash plant. Additional electric power could be used on site for the production of phosphoric acid and mixed fertilizers. It would be feasible to construct and operate a pilot food factory of the kind described on the basis of presently available nuclear and chemical engineering technology. (auth)

49645 AGRO-INDUSTRIAL COMPLEX. Michel, J. W. (Oak Ridge National Lab., Tenn.). pp 713-44 of Nuclear Desalination. New York, American Elsevier Publishing Co., Inc., 1969.

From Symposium on Nuclear Desalination, Madrid, Spain. See CONF-681108.

Results are presented of a study of the technical and economic feasibility of nuclear-powered industrial and agro-industrial complexes, primarily as an avenue to industrial, agricultural and general economic advancement in developing countries. Such a complex would consist of a large nuclear reactor station producing both electricity and desalted water; the electricity would be consumed in adjacent industrial processes and for pumping water while the desalted water could be used either for municipal and industrial purposes or in an irrigated agricultural complex located in a coastal desert region. Basic information was developed on the cost of producing industrial products which require significant amounts of electricity and of producing a variety of basic food crops. The general economics of combining a nuclear-electric generating station, an industrial complex, and a large agricultural enterprise into an agro-industrial complex was evaluated for two levels of assumed technology for the nuclear desalination plant. The effects on the economic return of size, changes in product mix and sales price levels, and of operation with bypass steam to reduce the generation of electricity were also determined. Five typical coastal desert locales were briefly examined to test the adaptability of this concept to real world conditions. The results of this study project were generally encouraging from both the technological and the economic feasibility standpoints. The great importance of producing products suited to local resources and the sensitivity to assumed price levels emphasize the need for a much more detailed analysis before a specific implementation could be attempted. (auth)

49646 DUAL-PURPOSE NUCLEAR POWER PLANT INCORPORATING THE PRODUCTION OF SALT. Kakihana, H. (Tokyo Inst. of Tech.); Tsunoda, Y. pp 745-55 of Nuclear Desalination. New York, American Elsevier Publishing Co., Inc., 1969.

From Symposium on Nuclear Desalination, Madrid, Spain. See CONF-681108.

A plan for the utilization of seawater is proposed. This process is characterized by the use of special types of anion and cation exchange membranes in electrodialysis, a process that is incorporated into the evaporation step of a dual-purpose nuclear power plant. By using such special membranes, scaling in the heat-exchanger of the evaporator will be greatly reduced. This makes the distillation operation much easier and at the same time enables curtailment of the equipment cost. In its most simplified form, the products obtained by this process are electric power, fresh water and industrial salt. So the plant may be called a triple-purpose plant. In balancing the prices of all the products, greater economies can be expected than in the case of a dual-purpose plant.

Provided such a plant is large enough and its various by-products do contribute to the overall economy, this process will also enable the manufacture, in addition to the three items mentioned above, of magnesium hydroxide, chlorine, Glauber's salt, potassium chloride, gypsum and hydrogen. (auth)

49647 PRELIMINARY STUDY OF A DESALINATION-POWER-INDUSTRIAL COMPLEX IN ISRAEL. Adar, J. (Israel Atomic Energy Commission, Tel Aviv); Caplin, D.; Frank, G.; Tavory, O. pp 757-71 of Nuclear Desalination. New York, American Elsevier Publishing Co., Inc., 1969.

From Symposium on Nuclear Desalination, Madrid, Spain. See CONF-681108.

According to previous studies, a dual-purpose plant will be needed in Israel in the middle seventies to add some 300 MW(e) and 150 MGD to the national electricity and water grids. The profitability of combining with the dual-purpose plant an industrial complex fed by the low-cost incremental power (either electricity or low-pressure steam) of the larger reactor that would be required is examined. The study includes two parts: In the first part incremental costs of power are estimated. Instead of the 1860 MW(t) reactor required by the reference dual-purpose plant, medium and large standard sizes of US light-water reactors (2370 and 3300 MW(t)), or a combination of both sizes, are considered. Depending on the size and number of reactors and on the different steam cycles chosen, the amounts of incremental electricity and low-pressure steam available for the industrial complex vary respectively between 118 MW(e)–930 MW(e) and $0-3.95 \times 10^6$ lb/h. Depending also on the different fixed-charge rates considered, the respective costs vary between 1.82–5.5 mill/kWh and 0–76 ¢/MBtu. In the second part a preliminary survey of "process industries" (chemical and metallurgical) is made. Processes were selected according to marketing possibilities for the products or their derivatives, preference for the utilization of local raw material and/or intermediaries, the advantage of processing in Israel certain minerals or mineral concentrates. The process should be power and steam intensive and consumption of power and/or steam at the capacity envisaged should be significant. Alternative processes, not power and steam intensive, should be noted and studied concurrently. Assuming power available at 3 mill/kWh and low-pressure steam at 20¢/MBtu, relative profitability was calculated. A minimum gross annual incremental profit was chosen for the purpose of eliminating processes from consideration. Eight processes, which together require more than 900 MW(e) at the capacities envisaged, were selected for further study. Specific conditions for some of the processes considered are discussed. Considerable additional study, including market survey, technological assessment and economic evaluation would be required to evaluate with an acceptable degree of accuracy the many possibilities envisaged. The effects of basic industries considered on the overall economic development of the country are reviewed. (auth)

49648 TECHNOLOGY NEEDED FOR THE ECONOMIC USE OF DESALTED WATER IN AGRICULTURE. Hammond, R. P.; Anderson, T. D. (Oak Ridge National Lab., Tenn.). pp 785-96 of Nuclear Desalination. New York, American Elsevier Publishing Co., Inc., 1969.

From Symposium on Nuclear Desalination, Madrid, Spain. See CONF-681108.

The present economic position of desalting in agriculture is summarized and the improved technology of nuclear reactors, desalination plants, and of crop production which is needed and the extent to which it appears to be forthcoming are discussed. For reactors, two important factors will affect energy costs in the future: the advent of very large units and the arrival of the advanced breeders. The economic consequences and the probable timing of each of these are discussed. For seawater evaporation equipment, the importance of enhanced heat-transfer surface and large plants on economics is emphasized, and recent developments in this direction are summarized. The possibility of special types of plant and energy sources for water-only stations is mentioned. (auth)

49649 STATEMENTS BY REPRESENTATIVES OF INDIA, CUBA, JAMAICA, SINGAPORE, AND AUSTRALIA. pp 797-802 of Nuclear Desalination. New York, American Elsevier Publishing Co., Inc., 1969.

From Symposium on Nuclear Desalination, Madrid, Spain. See CONF-681108.

Brief summaries of the extent of interest in nuclear desalination in each of the countries are presented. (H.D.R.)

Marine and Portable Power Reactors

49650 (DOCKET-50238-50) N.S. SAVANNAH. Corrective Action on Primary Pump Cavity Vent Piping Failure. (First Atomic Ship Transport, Inc., New York). Sept. 25, 1969. 2p. Dep. CFSTI.

Information concerning a leak in the cavity vent piping on primary coolant pump PS-P3 on the Maritime Pressurized-Water Reactor is included. (D.C.C.)

Reactor Theory

Refer also to abstracts 49308, 49552, 49555, and 49583.

49651 (ANL-7410, pp 387-442) REACTOR COMPUTATION METHODS AND THEORY. (Argonne National Lab., Ill.).

COMPUTATIONAL MODULAR SYSTEM — ARC, modules for, tabulation and description of
EXPONENTIAL PILES — lattices for, numerical comparison of neutron fission and capture rates for uniform and nonuniform
MATHEMATICS — difference equations, error analyses for linked
NEUTRON CROSS SECTIONS — formulation of microscopic multigroup, solutions to reactor physics calculations using
NEUTRONS — flux calculations for fast breeder reactors, technique for ultrafine adjoint
— wave propagation in fast multiplying media, use of multigroup transport theory for analyzing
— fission rates for uniform and nonuniform lattices, numerical comparison of
REACTORS — neutron diffusion equations for two-dimensional cylindrical, use of discontinuous variational synthesis technique for solution static multigroup
— kinetic equations for, formulations of microscopic multigroup cross sections for solution to
— neutron diffusion calculations for, use of group-space-dependent bucklings to simulate coordinate system transformations for
— kinetic equations for, error analyses of linked-difference,
REACTORS, BREEDER — neutron fluxes in fast, technique for calculating ultrafine adjoint
REACTORS, FAST — kinetics equations for large, evaluation of accuracy of factoring methods for space-dependent
— kinetics equations for large, shape functions for solution to quasistatic
— neutron diffusion equations for two-dimensional cylindrical, use of discontinuous variational synthesis technique for solution static multigroup
— kinetic equations for, formulations of microscopic multigroup cross sections for solution to
— neutron fluxes in breeder, technique for calculating ultrafine adjoint
— neutron wave propagation in, use of multigroup transport theory for analyzing
REACTORS, POWER — kinetics equations for large, evaluation of accuracy of factoring methods for space-dependent
— kinetics equations for large, shape functions for solution to quasistatic
REACTORS, WATER COOLED — neutron diffusion equations for two-dimensional cylindrical use of discontinuous variational synthesis technique for solution static multigroup
— kinetic equations for, formulations of microscopic multigroup cross sections for solution to (M.L.S.)

49652 (EURFNR-684) METHOD OF EVALUATING PROGRESSIVE SUBSTITUTION EXPERIMENTS FOR THE DETERMINATION OF BUCKLINGS AND CRITICAL RADII. Helm, Friedrich (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik). May 1969. 41p. (EUR-4175; KFK-975). Dep. CFSTI (U. S. Sales Only).

Work Performed under United States–Euratom Fast Reactor Program.

It is shown that the variation in critical radius upon substitution of a new composition in a central zone of a reactor can be approximated by a three-parameter equation, one of the parameters being $\Delta B_r/B_r$, the relative difference of the radial bucklings in the two reactor zones. A comparison with multigroup calculations shows the validity of the equations derived. Modifications are introduced which make them applicable for a considerable range of difference in the nuclear parameters of the two compositions. It is also shown that the presence of a reflector does not greatly interfere with the method. Finally an evaluation is given of three substitution experiments which were performed on the critical facilities SNEAK and MASURCA. 10 references. (auth)

49653 (FEI-136) CALCULATION OF THE VARIATIONS OF REACTIVITY EFFECTS WITH THE AID OF THE PERTURBATION THEORY. Zaritskii, S. M.; Rakitin, I. D. (Gosudarst-

vennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Fiziko-Energeticheskii Institut). 1968. 85p. (In Russian). Dep. CFSTI (U. S. Sales Only).

Gas-kinetic, diffusion and finite-difference formulas and equations of perturbation theory are presented. The equations are intended for calculating the variations of different reactivity effects, such as Na and Doppler reactivity coefficients. 11 references. (auth)

49654 (GA-9423) SCANAL: A SINGLE CHANNEL SYNTHESIS DEPLETION CODE WITH TRIANGULAR MESH IN THE HORIZONTAL PLANE. Traylor, R. C.; Malakhof, V.; Leighton, S. C. (Gulf General Atomic, Inc., San Diego, Calif.). July 1, 1969. Contract AT(04-3)-633. 143p. Dep. CFSTI.

The digital computer code SCANAL is described. SCANAL is designed to synthesize a three-dimensional power distribution from GAUGE and RELOAD FEVER analyses and to utilize the COPE code to calculate complete distributions of core moderator fuel, and coolant temperatures. The program is written for the UNIVAC 1108. (6 references) (D.C.C.)

49655 (IAE-1689) AUTOMATIZATION OF MEASUREMENTS OF REACTIVITY. Voronin, A. A.; Ostapenko, V. V. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Atomnoi Energii). 1968. 22p. (In Russian). Dep. CFSTI (U. S. Sales Only).

A general comparative evaluation was made of a method proposed for automatic reactivity measurements with regards to experimental feasibility, time, costs, and hazards involved. The method is based on the invariance theory and uses symbolic transfer functions and differential equations. (auth)

49656 (N-69-32562) STUDY OF ENERGY GENERATORS. Translated from a French Report. 6p. (NASA-CR-103443). CFSTI.

Achievements in theoretic neutronics are cited as the improvement of the Feinberg-Galanine method of heterogenous calculation and its application to experimental piles and power reactors, and the development of a more precise and rapid method for calculating the neutron transport equation. The evolution of the neutronic properties of fuels was studied, and programs were developed for calculating the decrease of fission product activity after the reactors were stopped. Also mentioned are techniques for remote welding and machining of tubular assemblies, electron bombardment welding of heavy boilers, and studies on graphite-moderated natural uranium lattices, graphite pile-up pulse structures, and graphite jackets for the EDF fuel. (STAR)

49657 (ORNL-tr-2213) WEIGHTING AND BIASING OF A MONTE CARLO CALCULATION FOR VERY DEEP PENETRATIONS. Lanore, Jeanne-Marie (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Translated for Oak Ridge National Lab., Tenn., from a French report. 17p. Dep. CFSTI.

From the solution of the adjoint to the transport equation, a weighting and biasing system is developed permitting one to obtain a constant variance in every point of the phase space which is strict in a particular case and nearly strict in the general case by means of the Monte Carlo method. Neutron spectra at a very great distance from the source are then derived with accuracy. (5 references) (auth)

49658 (ORNL-tr-2221) STUDIES OF EVALUATION ERRORS OCCURRING IN ROD-DROP EXPERIMENTS. Koehler, G. Translated by R. Gregg Mansfield (Oak Ridge National Lab., Tenn.), from Kernenergie, 10: 331-6(1967). 13p. Dep. CFSTI.

The change of spatial distribution of the neutron flux, for the most part neglected in rod-drop experiments, has an appreciable effect on the result in power reactors. This effect is investigated in an example by expansion by eigen functions and by means of the space-time synthesis. A rule for correction of the measured values in order to obtain useful results for the reactivity of the control elements is derived. 8 references. (auth)

49659 INTENSIVE TEMPERATURE COEFFICIENTS OF REACTIVITY CAUSED BY THERMAL NEUTRONS. Isbasescu, Mihai (Institutul de Fizica Atomica, Bucharest). Stud. Cercet. Fiz., 21: 179-95(1969). (In Rumanian).

The thermal neutron multiplication coefficient in the reactor cell is calculated. The Boltzmann equation for thermal neutrons in a field of temperatures is derived. Reaction rates and their temperature coefficients are calculated. Monoenergetic diffusion theory results; "Spectrox" approximation results; and $P_{\infty}G_{\theta}$ approximation results are included. 8 references. (auth)

49660 FLUX DEPRESSION PRODUCED BY THERMAL NEUTRON DETECTOR CALCULATED WITH INTEGRAL TRANSPORT THEORY. Boeriu, St. (Institutul de Fizica Atomica, Bucharest). Stud. Cercet. Fiz., 21: 137-44(1969). (In Rumanian).

Starting from the monoenergetic Bolzmann equation, the method of the integral transport theory in calculating the flux depression by neutron detectors is described. The general conditions and equations are given and solved for the particular case of a homogeneous and infinite medium. In this particular case the neutron flux depression is calculated by a fission chamber. 10 references. (auth)

49661 DIRECT CRITICALITY SEARCH IN SOLUTION OF FINITE-DIFFERENCE EIGENVALUE PROBLEMS. Vondy, David Ray. Knoxville, Tenn., Univ. of Tennessee, 1968. 188p. Thesis.

The system of finite-difference equations which couple the neutron flux values at discrete points in phase space was cast into the general eigenvalue problem for a steady-state condition. The feasibility of direct iteration toward a specified steady-state condition, "direct search," was demonstrated by computer calculations. A study was made of the equations and iterative behavior of calculations for the directed neutron flux in one-dimensional slab geometry with anisotropic scattering and multi-group treatment of the energy variable. Calculations were also performed using Carlson's S_n equations. Several problems encountered in analysis of a variety of nuclear reactor cores were solved by application of the direct search techniques to the formulation associated with the diffusion approximation to neutron transport. Comparison of the iterative behaviors of direct search and usual eigenvalue solutions indicates that only little additional effort is usually required for the former. Thus it is practical with effective iterative procedures to satisfy steady-state conditions directly. Considerable use of the direct search technique is expected in analysis of nuclear reactor cores. (Diss. Abstr.)

49662 HOMOGENISATION OF A THREE DIMENSIONAL HETEROGENEOUS REACTOR LATTICE ARRAY WITH BOILING COOLANT AND/OR MODERATOR LATTICE CELL REGIONS. Barrett, P. R. (Univ. of New South Wales, Kensington). Nukleonik, 12: 230-4(Aug. 1969).

For a regular array of identical lattice cells each transversely symmetric about its center and each containing regions of boiling coolant and/or moderator, homogenized cell diffusion theory equations are obtained for the variation of the statistical average of the neutron flux distribution. The stochastic nature of neutron interactions with nuclei and the random nature of the boiling regions of a lattice cell are accounted for. The homogenized medium diffusion theory parameters are found in general to contain mixed averages of the neutron concentration distribution and the distribution of the nuclear concentration in the regions of the random medium. It is shown that, if the statistical distribution of the nuclear concentration is assumed known from thermal and hydrodynamic theories, all of the required mixed averages may be evaluated by means of a theoretical examination of the equivalent infinitely repeated lattice cell array. (auth)

49663 DETERMINATION OF ANISOTROPIC DIFFUSION PARAMETERS APPROPRIATE TO THE HOMOGENISATION OF A THREE-DIMENSIONAL HETEROGENEOUS LATTICE ARRAY. Barrett, P. R. (Univ. of New South Wales, Kensington). Nukleonik, 12: 223-30(Aug. 1969).

The problem of the description of a regular array of lattice cells by means of a homogenized system diffusion theory formulation is considered by means of a truncated Taylor series expansion of the macroscopic neutron flux. This leads to expressions for the anisotropic diffusion coefficient components in terms of "directed" collision probabilities, "directed" mean free paths and "directed" mean square free paths, all of which occur in simple integral forms. Allowance is made for linearly anisotropic scattering and for the possibility of having macroscopic cross-sections that vary weakly in the axial direction of the lattice cells. (auth)

49664 EFFECTIVE RESONANCE INTEGRAL CALCULATION IN PROBLEM OF RESONANCE ABSORPTION OF NEUTRONS IN HETEROGENEOUS REACTORS. Fam Zui Hien. At. Energ. (USSR), 27: 3-5(July 1969). (In Russian).

A new approximate analytic expression of the effective resonance integral in the problem of resonance absorption of neutrons in heterogeneous reactors is derived. Some estimates for the errors of this expression are also given for some special cases. (auth)

49665 OPTIMIZED SCATTER-LOADING OF NUCLEAR POWER REACTOR. Stover, Roger Lester. Lafayette, Ind., Purdue Univ., 1968. 174p. Thesis.

A computer program, MINFUL, was written to determine loading decisions which lead to a minimum fuel cycle cost in a scatter-loaded boiling water reactor. In scatter-loading, a uniform fraction of the core is replaced with fresh fuel at each reload point in the life of the reactor. Determination of these optimal loading fractions requires a methodical search among all possibilities. Typical results show a decrease in fuel cycle cost of 5.6 percent from an off-optimum ⅓ batch loading cost. The batch cost for all 3 systems considered is 2.17 mills/kwh. For a plant life of 15 years, the optimum fuel cycle cost for the 1-zone reactor is 1.69 mills/kwh, the 3-zone uniform loading cost is 1.74 mills/kwh, and the 3-zone non-uniform loading cost is 1.67 mills/kwh. Variation of decision values indicated that within a volume fraction range of 5 percent, the specific choice of loading fraction at a given stage is not as important as correct loading sequences over several stages. The MINFUL computer program was written in Fortran-IV for the IBM-7094 and CDC-6500. For investigation of non-uniform scatter-loading, a larger version with random access files was written in Fortran-IV and Compass for the CDC-6500. Running times varied from 0.1 to 5 minutes for problems using Elimination of Similar End States, and up to 90 minutes for exhaustive search calculations. (Diss. Abstr.)

49666 USE OF GENERALIZED PERTURBATION METHODS FOR OPTIMIZATION OF REACTOR DESIGN. Gandini, A.; Salvatores, M.; Sena, G. (CNEN-CSN, Rome). J. Nucl. Energy, 23: 469-75(Aug. 1969).

A method is described which adopts the generalized perturbation theory and programming techniques for optimizing reactor integral parameters, linear or bilinear in the real and adjoint neutron fluxes, after assumption of given constraints. An application of this method to the optimization of the Be distribution, with respect to the Doppler effect in a fast ceramic test reactor, is illustrated. (auth)

49667 HALF-SPACE GENERAL MULTIGROUP TRANSPORT THEORY. Pahor, S.; Shultis, J. Kenneth (Univ. of Michigan, Ann Arbor). J. Nucl. Energy, 23: 477-93(Aug. 1969).

A method for solving various half-space multigroup transport problems for the case of a general transfer matrix is explained. A non-linear integral equation for the emergent distribution of the albedo problem is derived. Then, by using the full-range completeness of the infinite medium eigenfunctions, the distribution inside the half-space is obtained from the emergent distribution. Finally, the Milne problem and the half-space Green's function problem are solved in terms of the emergent distribution of the albedo problem and the infinite medium eigenfunctions. The method readily yields numerical results for emergent distributions of half-space problems. (auth)

49668 SURVEY CODE FOR FAST BREEDER REACTOR. Kawasaki Giho, No. 34, 116-21(Apr. 1969). (In Japanese).

AIMPDS-A one dimensional multigroup diffusion code, which is based on AIM-6, PDS and FOG-3, is suitable to survey the characteristics of fast breeder reactors. It includes nine criticality search options and transverse buckling iteration option. The transverse buckling iteration is described. Power distribution search results are presented. (auth)(NSA of Japan)

49669 DETERMINATION OF THE TEMPERATURE COEFFICIENTS OF REACTIVITY OF A REACTOR BY ANALYSIS OF ITS RESPONSE TO A RAMP INPUT. Palabrica, Ricardo deJesus. Charlottesville, Va., Univ. of Virginia, 1968. 222p.
Thesis.

A ramp input technique is described for measuring temperature coefficients of reactivity. A linearly-varying input is used to perturb an initially critical reactor. The temperature coefficients are obtained from the resulting flux response and the knowledge of the reactivity insertion rate. Unlike the pile oscillator method, the ramp input method permits measurement without necessitating access to the core or requiring any special equipment. The input reactivity is obtained by a mere withdrawal of a control rod which is already built into the system. Also, unlike the trapezoidal input method, the possibility of irregularities in the control rod motion is very remote, since the control rod is not alternately driven in and out of the core. (Diss. Abstr.)

Experimental Applications

49670 APPLICATION OF THE PROBABILITY DISTRIBUTION OF NEUTRON COUNTS FOR THE INTERPRETATION OF THE DIGITAL FLASH-START EXPERIMENTS. Mikulski, Andrzej T. (Inst. of Nuclear Research, Swierk, Poland). Nukleonik, 12: 235-7(Aug. 1969).

The probability distribution of neutron counts in two intervals derived from the probability generating function is very useful for interpretation of the digital flash start experiments (conditional Rossi-α). It was used for the determination of the best experimental conditions—the highest amplitude to background ratio, and for investigation of limits in the source sensitive version of this method. A comparison with results from experiments using a Monte-Carlo simulated reactor noise was made. (auth)

49671 DETERMINATION OF NEUTRON SLOWING-DOWN PARAMETERS BY PULSED SOURCE METHOD. Chwaszczewski, S.; Mikulski, A. T. (Inst. of Nuclear Research, Swierk, Poland). Nukleonik, 12: 218-23(Aug. 1969).

The possibility of neutron slowing-down parameters determination using pulsed neutron sources is investigated. For measurement interpretation, the P-function was derived on the basis of the neutron diffusion approximation. The measurements were performed with nuclear grade graphite and light water. The results of measurements show the applicability of P-function for calculation of neutron slowing-down parameters and interpretation of pulsed experiments. (auth)

49672 STUDIES OF REACTOR NOISE EXPERIMENTS BY MONTE CARLO METHOD. Mikulski, Andrzej T. (Inst. of Nuclear Research, Swierk, Poland). Nukleonik, 12: 211-17(Aug. 1969).

Presented are the reactor noise experiments by interval distribution, p-method and conditional Rossi-α studied by the Monte-Carlo method. The reactor is described by a one point model without delayed neutrons. (auth)

Reactor Components, Fuels, and Accessories

Refer also to abstracts 47371, 47597, 47599, 47668, 47676, 47683, 47690, 47695, 47708, 47717, 47740, 47813, 47880, 47911, 48315, 48317, 48338, 48362, 48396, 48464, 48496, 48502—48504, 48507, 48509, 48514, 48518, 48544, 48548, 48572, 48574, 48576, 48580, and 48582.

49673 POST-INCIDENT DEVICE FOR NUCLEAR REACTORS. Tagami, T.; Inoue, K. (to Hitachi, Ltd.). Canadian Patent 812,450. May 6, 1969. Priority date Dec. 15, 1964, Japan.

The walls of a reactor containment structure have a large number of nozzles distributed over the inside surface area. In the event of failure of a primary coolant duct causing steam pressure to be built up in the containment space, cool water sprays from the nozzles to condense the steam. This effect is accomplished automatically by a system of conduits and pistons or rotor blades connected by pipes to nozzles spread over the containment dome surface. In normal operation, the containment space is at atmospheric pressure and the nozzles remain closed. A pressure increase actuates the piston system so that cool water is forced out of the nozzles as spray. (F.S.A.)

49674 SYNTHESIS OF COUPLED REGULATORS SYSTEM FOR POWER DISTRIBUTION CONTROL IN A NUCLEAR REACTOR. Potapenko, P. T. At. Energ. (USSR), 27: 189-93(Sept. 1969). (In Russian).

The problem of automatic control of radial power distribution in a nuclear reactor is analyzed. In order to achieve control and regulation, the reactor core with control rods is divided into n equal cells, each cell having a neutron flux detector placed in the center. The cells contain equal number of rods which while in operation move in a synchronous manner. The inverse electrical reactor simulator is used for disconnecting of local regulators to improve transient processes. The scheme and calculation procedure for the inverse reactor simulator are described in detail. Matrix equations for multichannel control system are solved. 7 references. (auth)

49675 NUCLEAR FUEL ELEMENT. Lass, James L. (to General Electric Co.). U. S. Patent 3,466,226. Filed Aug. 25, 1967.

A nuclear fuel element is described in which a thin unbonded metal wafer is included between the fuel material and a cladding tube closure such as an end plug or an intersegment connector. The wafer introduces a second thermal interface between the wafer and end plug or connector, in addition to the thermal interface between the fuel and the wafer. This serves to prevent overheating and the resulting excessive volumetric expansion of the end plug or connector during reactor operation. (Offic. Gaz.)

GENERAL

49676 (K-1881) HYDROGEN FLUORIDE CYLINDER FAILURE. Ziehlke, K. T.; Petit, G. S.; Kimmerly, E. Y.; Weber, C. W. (Oak Ridge Gaseous Diffusion Plant, Tenn.). Sept. 16, 1969. Contract W-7405-eng-26. 19p. Dep. CFSTI.

An anhydrous hydrogen fluoride cylinder released its contents in an explosive manner. The valve cap, valve, and valve boss assembly separated from the cylinder in the heat-affected zone of the boss-to-cylinder weld. Internal hydrogen pressure and a preexisting crack in the cylinder were evident factors in the failure. Eight adjacent cylinders stored under similar conditions were considered potential hazards, and precautions were taken to minimize the risk from these cylinders. (auth)

49677 (MLM-1689) VOLUMETRIC ESTIMATION OF ASCORBIC ACID WITH TETRAVALENT MANGANESE. Silver, G. L. (Mound Lab., Miamisburg, Ohio). Sept. 26, 1969. Contract AT-33-1-GEN-53. 7p. Dep. CFSTI.

Dilute solutions of manganese(IV) were prepared by reduction of potassium permanganate with dimethyl sulfoxide. Solutions of manganese(IV) may be used for volumetric estimation of certain reductants such as ascorbic acid, but no advantages of manganese(IV) over potassium permanganate for redox titrations were found. (auth)

49678 (NP-18017) LOCAL MAGNETIC MOMENTS IN DILUTE ALLOYS. Kjoellerstroem, Bengt (Lund Univ. (Sweden)). 1969. 16p. Dep. CFSTI (U. S. Sales Only).

A dissertation based on five papers is presented on dilute alloys where atoms of transition metals are substitutionally introduced in a nonmagnetic host such as one of the noble metals. The problem is analyzed formally, and it is shown that a local magnetic moment cannot be formed at zero temperature. The physical properties of the alloys are discussed. (D.L.C.)

49679 (SC-DR-69-291) AEROBALLISTIC, PERFORMANCE, WIND EFFECTS, AND PAYLOAD IMPACT DISPERSION ANALYSES AND FLIGHT TEST DATA FOR THE SINGLE-STAGE SANDHAWK ROCKET SYSTEM. Wilson, Gerald G.; Stone, George W. (Sandia Labs., Albuquerque, N. Mex.). July 1969. 129p. Dep. CFSTI.

The single-stage Sandhawk is a solid-propellant, fin-stabilized, unguided rocket system capable of carrying 200 pounds gross payload weight to an apogee altitude of 568,000 feet. The rocket incorporates either a 12-inch or a 13-inch-diameter ogive-cylinder, varying from 90 to 107 inches in length and having sufficient volume for a variety of rocket-launched experiments. Aerodynamic, performance and flight test data, together with the results of wind effect and dispersion analyses, are presented. (auth)

49680 (SC-RR-69-368) POPULATION DISTRIBUTION ANALYSIS OF THE WORLD. Blake, V. E. (Sandia Labs., Albuquerque, N. Mex.). July 1969. 14p. Dep. CFSTI.

An analysis of the population distribution of the world and of the band between 35°S and 35°N latitudes is presented. (auth)

49681 (SCL-RR-69-80) ANALYSIS OF SHALLOW SPHERICAL CANTILEVER SHELLS AND SHALLOW SPHERICAL DOMES WITH POLAR OPENINGS UNDER ANTISYMMETRICALLY DISTRIBUTED LOADS. Fettahlioglu, Oemer A. (Sandia Labs., Livermore, Calif.). Sept. 1969. Contract AT(29-1)-789. 254p. Dep. CFSTI.

A mathematical analysis of the stresses and deflections in thin shallow spherical shells subjected to antisymmetrical distributed loads is presented. The shells are considered to be of constant thickness and isotropic construction and to be supported continuously either near the apex or along the outer boundary by a rigid ring. A simplified yet accurate analysis is accomplished by the application of bending shell theory. The equations are specialized to provide solutions for either fixed or simple support configurations. Results are presented in the form of nondimensional curves which provide stress resultants and displacements in the most general form. (auth)

49682 (TID-85(7th Rev.)) REPORT NUMBER SERIES USED BY THE DIVISION OF TECHNICAL INFORMATION IN CATALOGING REPORTS. White, Helen W. (comp.) (Division of Technical Information Extension (AEC), Oak Ridge, Tenn.). Sept. 1968. 71p. Dep. CFSTI.

The seventh revision is presented in two parts. Part 1 is an alphabetical listing of report series codes identified with the corporate or issuing organization. Part II is a listing of the organizations followed by report series each has used. (B.G.D.)

49683 (TID-3754) BIBLIOGRAPHIES OF ATOMIC ENERGY LITERATURE. Issued or in Progress During the Period July-August 1969. (Division of Technical Information Extension (AEC), Oak Ridge, Tenn.). 8p. Dep. CFSTI.

49684 (UCRL-19011) COMPUTER PROGRAMS FOR AN IMPROVED EQUATION OF STATE (ES68Z AND ES68M). Redlich, Otto; Ngo, Victoria B. T. (California Univ., Berkeley. Lawrence Radiation Lab.). May 1969. Contract W-7405-eng-48. 69p. Dep. CFSTI.

Two FORTRAN programs for the use of the new modification of the equation of state of Redlich and Kwong are presented and their application is described in detail. Program ES68Z computes the compressibility factor for a flexible temperature-pressure schedule. Program ES68M leads, in addition, to fugacity coefficients, enthalpies, and entropies. It can be used for mixtures and furnishes individual fugacity coefficients. (auth)

49685 (UCRL-50704) THE VAPOR PRESSURE OF PENTAERYTHRITOLTETRANITRATE (PETN) IN THE TEMPERATURE RANGE OF 50 TO 98 DEGREES CENTIGRADE. Crimmins, Francis T. (California Univ., Livermore. Lawrence Radiation Lab.). July 11, 1969. 11p. Dep. CFSTI.

The vapor pressure of pentaerythritoltetranitrate (PETN) was determined in the temperature range from 50 to 98°C using the effusion technique developed by Knudsen. A least-squares reduction of the experimental data gave the following equation: $\log_{10} P_{mm} = 14.44 - 6352/T$. The enthalpy or latent heat of sublimation calculated from this equation is 29.0 kcal/mole. (auth)

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